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FORTY-EIGHTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

THIRTEENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1900.

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The Board of Agriculture

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State Board of Agriculture, 1901.

Members ex Officio.

His Excellency W. MURRAY CRANE.
His Honor JOHN L. BATES.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

	Term Expires
WILLIAM R. SESSIONS of Springfield,	1902
FRANCIS H. APPLETON of Peabody,	1903
WARREN C. JEWETT of Worcester,	1904

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1903
Barnstable County,	JOHN BURSLEY of West Barnstable,	1904
Berkshire,	WESLEY B. BARTON of Dalton,	1903
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1903
Bristol County,	EDWARD M. THURSTON of Swansea (P. O. South Swansea),	1902
Deerfield Valley,	HENRY A. HOWARD of Colrain,	1902
Eastern Hampden,	O. E. BRADWAY of Monson,	1903
Essex,	JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre),	1902
Franklin County,	JOHN S. ANDERSON of Shelburne,	1904
Hampshire,	A. M. LYMAN of Montague,	1904
Hampshire, Franklin and Hampden,	H. C. COMINS of Northampton,	1903
Highland,	C. K. BREWSTER of Worthington,	1902
Hillside,	ALVAN BARRUS of Goshen (P.O. Lithia),	1902
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1903
Hoosac Valley,	GEO. P. CARPENTER of Williamstown (P. O. Blackinton),	1903
Housatonic,	CHARLES B. BENEDICT of Egremont,	1903
Man'f'trs' Agr'l (No. Attleborough),	OSCAR S. THAYER of Attleborough,	1903
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1903
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1904
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1903
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1903
Middlesex North,	JOSHUA CLARK of Tewksbury (P. O. Lowell),	1904
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1902
Nantucket,	J. S. APPLETON of Nantucket,	1903
Oxford,	W. M. WELLINGTON of Oxford,	1904
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1902
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1904
Union (Agr'l and Hort'l),	ENOS W. BOISE of Blandford,	1904
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1903
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1902
Worcester East,	W. A. KILBOURN of South Lancaster,	1903
Worcester North-west (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P.O. Athol Centre),	1904
Worcester South,	C. D. RICHARDSON of West Brookfield,	1904
Worcester County West,	CHAS. A. GLEASON of New Braintree,	1903

THE FORTY-EIGHTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

The agriculture of Massachusetts has been fairly profitable the past year, notwithstanding the severe drought, most severely felt in the eastern portions of the State.

The policy of the State is wisely liberal to agriculture, and well it may be, for the productive industries measure the true wealth of State or nation. More than eighty per cent of the country's exports for the last ten years have been agricultural. The farmers of this State are fortunate in having a good market at their doors, and in being able to largely supply this market direct from producer to consumer, thereby obtaining the best possible return for their products.

With the electric railways now connecting the towns and the villages with the larger centres, the farm is to-day simply suburban to our great cities. The free rural delivery of the mails is another factor of great importance that will soon reach every town and hamlet in the State. The farmers of the State are to-day, as never before, looking for the latest improvements and the best methods. Never before has the report of the Board been practically exhausted within the first year; never before has the secretary been importuned for lecturers and institute speakers as

now. All these indicate the change that is rapidly taking place, — the advance that is being made in the agriculture of the State.

Standing at the threshold of a new century, filled with an optimism that we believe the circumstances warrant, we repeat the words of an address written one year ago, as an inspiration and a prophecy: —

To-day the agriculture of New England is improving. Of Massachusetts I know of what I affirm. The farmer is not discouraged or downhearted to-day, but looks forward to the coming prosperity, and goes forth to meet it. He believes the undue burdens now resting on his labor are to be removed, and as never before he realizes his strength. The farmer is getting to believe in himself and to have greater faith in his brother. He realizes the dignity of his calling, its importance to the State, its right to favor. He sees that through co-operation and united effort much can be accomplished to improve his condition and advance his position.

Competition with the west in the great grain staples for a while led to loss and hardship, even as the west has since suffered by the competition of Russia and India; but to-day New England has found other channels of industry more profitable and better adapted to her soil, her markets and her people. Looking forward, we see the fruits of summer grown in January in our own greenhouses, more profitably than in their proper season. We see our own dependent population supplied with every luxury by New England enterprise on New England soil. We see the farmer taking his old stand as a leader in all good enterprises. We see his sons, educated and strong, taking their rightful place and exerting their old-time influence, — the strength of the hills, the backbone of the cities. We see the electric car speeding its way from town to town and from village to village, carrying the child to the larger and better schools, and giving free mail delivery to the homes of the country as to the city. We see equal taxation resting "like the atmosphere" on rich and poor alike, — every man according to his ability. We see the trusts that hold the farmers in their iron grasp destroyed or made to subserve righteous ends for the benefit of all. We see the bright day when arbitration shall settle the differences of the nations, as law now settles the disputes between individuals, and war's costly tribute shall cease. We see the home in which all comforts are found and all graces abound, its approaches lines of beauty, its crown of blessing the love and contentment that dwell therein. We see wealth of character and honesty of purpose

and life honored more than gold, and honest industry more prized than the indolence of wealth. Money valued for the good it can do, "the man the gold for a' that." We see all this, not as a mirage or a far-distant view, but growing nearer and nearer, and never hastening so rapidly to its accomplishment as to-day. I may not look upon its grand fulfilment, but the day-star has risen, the dawning of the coming day brightens the eastern sky, the mists disperse, the mountain tops are already in view, and some of you that read these words shall see its fulfilment.

Changes in the Board.

The changes in the membership of the Board resulting from elections by the several societies will be noted in the report of the committee on credentials.

During the year now past the Board has lost by death two of its honored members, appointees of the Governor, and both with long and valuable record for services on the Board and in the cause of agriculture.

Hon. James S. Grinnell of Greenfield was one of the original members of the Board at its formation forty-nine years ago, and had served either by election of the Franklin County Agricultural Society or by appointment by the Governor, excepting during the years 1853–56 and 1863–77 inclusive, until his resignation on account of his infirmities one year ago.

Mr. Dwight A. Horton of Northampton began his service on the Board in 1889 by election by the Hampshire Agricultural Society. In 1892 he was appointed by the Governor as one of the three members at large. As a member of the Dairy Bureau, to which position he was appointed in 1891, as its chairman since 1896 to the time of his decease, Mr. Horton's service was continuous and valuable. At the winter meeting of the Board at Worcester, President H. H. Goodell, Ex-Secretary Wm. R. Sessions and senior member of the Board Edmund Hersey were appointed to draft a tribute to the memory of these deceased members, and their report will be found printed on page 208 of this volume.

Meetings of the Board.

A special field meeting of the Board was held at the Daniel Webster farm in Marshfield, September 4, and a special

business meeting was held in connection with the public winter meeting at Worcester, December 4–6, accounts of which meetings will be found on pages 11–14 of this volume.

The public winter meeting for lectures and discussions was held at Worcester, December 4–6. The lectures and discussions will be found printed on pages 17–204 of this volume. The annual business meeting was held at the office of the secretary, Jan. 8 and 9, 1901, and the minutes thereof, etc., will be found printed on pages 207–257 of this volume.

HISTORY OF THE SUMMER MEETING.

To the future historian of the Board the inauguration of the summer meeting may be of interest, and should have place in our records. In the report of the special committee on farmers' institutes at the last annual meeting the following recommendation is found, viz.: "And we further recommend that the Board inaugurate the system of holding one summer institute meeting each year, at such time and place as shall be decided upon by the Board; and that the secretary shall provide subjects and speakers for the occasion." At the close of the first day's session the Board received an invitation from Walton Hall, Esq., the retiring delegate from the Marshfield Agricultural and Horticultural Society, to hold a summer meeting at his residence in Marshfield, — the Daniel Webster farm. The pleasant relations of the Board with Mr. Hall, the very cordial invitation and the historic surroundings of the place induced its immediate acceptance, and the decision of the question of a summer meeting was thus unexpectedly solved before the report of the committee came before the Board for its acceptance. Our host was unremitting in his attentions, the ocean contributed its share, and the peach orchard in which we were invited to pluck and eat was a thing of beauty and joy. Hon. James Wilson, Secretary of Agriculture, had accepted an invitation to be present and address the Board on the work of the United States Department of Agriculture, but failed to appear; but with such speakers as President Goodell, Hon. Wm. R. Sessions, Mr. Hall, and reminiscent

remarks by many members of the Board, the afternoon passed delightfully and all too quickly. With a vote of thanks to our host and a last look on the quiet resting-place of the great statesman and defender of Massachusetts, we bade adieu to Marshfield, convinced that a summer meeting under favorable conditions and with suitable addresses could be made the most profitable meeting of the year; and the revised draft of the by-laws of the Board, which will be submitted to you for action at this meeting, will provide for such a meeting as a permanent feature of the work of the Board.

Agricultural Societies.

The returns of the societies will be found printed on pages 484–491 of this volume.

The cattle shows and annual fairs are now criticised, and fair criticism is always welcome and should be carefully considered. That great good has been accomplished by these yearly exhibitions no intelligent person will deny. We see the great improvement in stock, both for profit and utility, the valuable acquisition of new and more profitable varieties in fruit, and wonderful creations of beauty in flowers, the thrift that comes from the desire to improve and to excel, all encouraged and stimulated by these fairs. This has been accomplished. Is the work complete? Have we reached perfection? or are there other opportunities and incentives that take the place of and supersede these fairs? We believe not, and therefore urge these societies receiving the State's bounty to consider the importance of using it judiciously for the benefit of agriculture. It behooves us to impress on the societies the importance of the best methods and the best work in the line of agricultural improvement. To this end I am convinced that the societies that are financially able should have suitable buildings for the comfort and exhibition of neat stock. To tie fine stock to a post or to a fence to stand all day after a hasty drive to the grounds, it may be in the hot sun or with a fierce wind blowing upon them, or in a cold sleet or a pouring rain, — and either of these is liable to happen, — is not a lesson of kindly treatment to animals, nor can there be an instructive exhibit of stock

under such circumstances. The best stock, distinctive in breed and perfect in condition, will not be exhibited at such a fair under such conditions. I am glad to see the improved cattle sheds being constructed on so many of our fair grounds, and believe we should encourage and almost insist that, where the society is financially able, these improvements should be made. I commend the society that last year mortgaged its grounds in part to provide suitable exhibition sheds for the stock. Very many of our societies are well equipped, and we are sure the number will enlarge each year, until all are well prepared for the most humane treatment of the animals and for intelligent and comparative study of their excellence.

Publications.

The following publications were issued by this office in 1900, and may be obtained on application : —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1899, .	732*	15,000	May 8.
Crop Bulletin No. 1, May, . . .	40	2,700	June 2.
Crop Bulletin No. 2, June, . . .	40	2,600	June 30.
Crop Bulletin No. 3, July, . . .	40	2,600	Aug. 3.
Crop Bulletin No. 4, August, . . .	40	2,600	Sept. 6.
Crop Bulletin No. 5, September, . .	40	2,500	Oct. 4.
Crop Bulletin No. 6, October, . . .	36	2,600	Nov. 5.
Descriptive catalogue of farms, eighth edition, ...	74	2,500	Sept. 27.
Farm catalogue supplement, No. 2, .	4	700	Dec 1.
Farmers' institute pamphlet, . . .	14	800	Dec. 17.

There were also issued in pamphlet form "Nature leaflets," Nos. 1–7; "Holland and its people," by Prof. Wm. H.

* Including twelfth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 125 pages.

Niles, being an excerpt from the "Agriculture of Massachusetts," 1899; a leaflet containing the tree warden and other laws; and an opinion of the Attorney-General on the duties of tree wardens.

Massachusetts Crop Reports.

The publication of monthly crop reports or bulletins was continued in 1900, and six in all were issued (May–October), aggregating 236 pages of printed matter.

The special articles included in these reports were: Bulletin No. 1, "Some insects injuring market garden crops," by Dr. H. T. Fernald; Bulletin No. 2, "Possibilities for farm forestry in Massachusetts," by Allen Chamberlain; Bulletin No. 3, "Birds as protectors of woodlands," by E. H. Forbush; Bulletin No. 4, "Poultry keeping on the farm," by Dr. A. A. Brigham; Bulletin No. 5, "The relation of agriculture to the public health," by Dr. S. W. Abbott; and Bulletin No. 6, "Soil exhaustion," by Dr. G. E. Stone. Bulletins 1, 3 and 6 were illustrated.

These special articles will be found printed on pages 261–351 of this volume. This department has been largely in charge of Mr. Legate.

Nature Leaflets.

During the past year this office issued seven illustrated leaflets of four pages each, called "Nature leaflets," upon the following subjects: "Canker worms," "Tent caterpillars," "Black knot of the plum and cherry," "Insecticides and fungicides," "White-marked tussock moth," "Spiny elm caterpillar" and "Potato and apple scab."

These leaflets were prepared to fill what seemed to be a real need, and it is the intention of the office to continue the series. Frequent requests for information on various subjects are received, and it is somewhat difficult at times to supply it in printed form. Again, specimens of insects are sent or brought to the office for identification, and a letter in reply is much more satisfying when accompanied by printed information.

It is believed that the teaching of nature study in our public schools has led some teachers to apply here for

printed matter on insects, birds, plants, etc. Just how much it is best for this office to undertake along this line is perhaps a question for the future to determine. If the encouraging and helping of those who are interested in the development of nature study in our public schools leads certain pupils to look to our Agricultural College as their future alma mater, this Board, as overseers of the college, have just cause for congratulation. This work has been largely done under the direction of Mr. Fowler.

Legislative Appropriations for Agricultural Purposes.

Objects for which appropriated.	1898.		1899.		1900.		1901.
	Appropriated.	Used.	Appropriated.	Used.	Appropriated.	Used.	Appropriated.
Bounties to societies,	$21,000 00	$19,933 17	$19,800 00	$18,871 51	*$20,329 25	$19,392 08	$19,800 00
Travelling and necessary expenses of the Board,	1,900 00	1,291 27	1,900 00	1,490 20	1,900 00	1,459 56	1,500 00
Travelling and necessary expenses of the secretary,	500 00	500 00	500 00	500 00	500 00	426 89	500 00
Incidentals in office of secretary,	800 00	800 00	800 00	800 00	800 00	800 00	800 00
Salaries of secretary and clerks,	5,500 00	5,500 00	5,500 00	5,500 00	5,500 00	5,500 00	5,700 00
Dissemination of useful information in agriculture by means of lectures or otherwise,	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00	2,800 00
Printing 15,000 copies of the "Agriculture of Massachusetts,"	5,748 69	5,748 69	5,442 52	5,442 52	5,332 69	5,332 69	†5,500 00
Collecting and circulating information relative to abandoned farms,	-	-	-	-	1,000 00	349 30	‡650 70
Carrying forward work of Dairy Bureau,	7,000 00	6,389 35	7,000 00	7,000 00	7,000 00	7,000 00	7,000 00
Salary of executive officer of Dairy Bureau,	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Salary of general agent of Dairy Bureau,	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00	1,200 00
Nails or spikes for marking shade trees for preservation,	200 00	-	200 00	174 11	300 00	196 77	200 00
Aggregates,	$47,148 69	$44,662 48	$45,642 52	$44,278 34	$47,161 94	$44,957 29	$46,150 70

* $529.25 on account of previous year. † Estimated. ‡ Unexpended balance.

Also the Legislature of 1900 made the following regular annual appropriations: for maintaining an agricultural experiment station at the Massachusetts Agricultural College, $10,000; for the said college, for free scholarships, $10,000; for the said college, for labor fund and extra instruction, $10,000; for travelling and other necessary expenses of the trustees of the said college, $800; to defray expenses of collecting and analyzing samples of concentrated commercial feed stuffs, $1,200, and for maintenance of the veterinary laboratory at the said college, $1,000. The Legislature also appropriated for the said college the sum of $8,000 to provide the theoretical and practical education required by its charter and the law of the United States relating thereto; also $19,000 for carrying forward the work against the gypsy and brown-tail moths.

Tree Wardens.

The usual appropriation of $200 was made for the purchase of M-spikes and washers, $196.77 of which was expended before June 1. In an appropriation bill approved June 20 a further appropriation of $100 was made, but was not drawn upon, owing to the rendering of an opinion by the Attorney-General, June 9, based on the tree warden law of 1899, that "There is, therefore, no further need of designating shade trees by any such distinguishing mark; and, under the powers granted to the tree wardens, the selectmen have no longer any right of interference or control. I am of opinion, therefore, that you are not called upon to furnish M-spikes to towns, but that as to cities the law remains unaffected."

The election of tree wardens at the March town meetings, under the provisions of the tree warden law of 1899 (chapter 330), resulted in a greatly increased demand for M-spikes in the spring months, there being 6 requests in March, 38 in April, 24 in May and 7 in June. After the receipt of the opinion above referred to, this office did not feel warranted in purchasing more M-spikes, the supply on hand being nearly exhausted, but printed the opinion of the Attorney-General, and mailed a copy to each of the tree wardens for their information and guidance.

The supplying of these spikes was begun in December, 1891, and the records of this office show that since that date there have been supplied approximately 8,000 3¼ inch large spikes, 31,000 3¼ inch small spikes, 119,000 2¾ inch spikes and 107,000 2¼ inch spikes, 265,000 in all, with accompanying washers. These spikes and washers were sent to 6 cities and 127 towns.

Tree wardens elected under the law of 1899 have in a number of instances called upon this office for interpretation of the law or for advice as to what they should do or should not do in the performance of their duties. Without doubt some help has been given such inquirers, but, as the law referred to did not originate with this Board, and the Board is not mentioned in the law, the position of this office has been somewhat conservative. These requests came no doubt largely because it has been the duty of this office to furnish M-spikes.

Forestry and Roadside Improvement.

Our Board has its committee on forestry, roads and roadside improvements. This is perhaps at the present time one of the most important committees of the Board. The condition in which the laws on this subject are now found to be by the decision of the Attorney-General demands a careful revision in the form of a new law, and the questions are many and important. It requires the best thought and study to frame a law that shall preserve the beauty without being oppressive and that shall protect the wayside owner from injustice. We all recognize that there is a money value in wayside improvement, and to enhance this we want a law that shall generally receive the co-operation of the wayside owners. Again, is it wise that the tree warden shall be the autocrat, or should there be an appeal to the higher authority of the selectmen in towns, the parks or street commissioner in cities?

Perhaps the owner is artistic in his ideas, and delights in irregular grouping and vistas. The tree warden is of a mathematical, methodical turn of mind, and with him certain respectable trees set at equal distances and on exact lines, and pruned of nature's negligence, is beauty. How can two

so diverse in ideas get along without friction? True, it is said that the tree warden is elected every year, and, if an unwise choice is made, it can be remedied at the next election; but the tree warden in thirty minutes can destroy what thirty years cannot replace. This is simply one illustration of the importance of a wise law.

We are all in favor of roadside improvement; the law is needed; it must be our work to make it as effective, as perfect as we can. I therefore suggest that the forestry committee meet with the secretary at the proper time, to make such suggestions as shall be a benefit to abutters, to the travelling public and to the State.

Farmers' Institutes.

During the year 1900 121 farmers' institutes were held under the auspices of the several societies. All of the societies represented on the Board, except the Massachusetts Society for Promoting Agriculture, held the required 3 institutes and 9 societies held 4 or more. In addition, 6 institutes were held in sections where there was no near-by society. The average attendance at 118 of the institutes, 3 not being reported, was 91. At 15 of the institutes the attendance was 200 or over; at 27 it was 100 to 200; at 39 it was 50 to 100; at 37 it was less than 50. In some cases the attendance was materially decreased owing to severe storms. This office supplied 100 lecturers during the year, at a total cost of $1,627.73, or $16.27 per lecturer.

This department is largely in charge of Mr. Legate, and has been well and efficiently administered. It is essential that as long notice as possible should be given the secretary's office of date, subject and speaker wanted. Equally important is it that the public have sufficient notice of such institutes. One or two days' notice is not sufficient, we deem it, for the opportunity of the farmer or the comfort as well as the best work of the lecturer. It is not creditable to the State Board, much less to the society, with such speakers as our list furnishes from this and other States, that the institute lacks attendance because the first notice many interested had of the institute was the report of its proceedings in the press.

LEGISLATION.

The legislation of 1900 having reference to the Board of Agriculture or to the agricultural societies was "An act making appropriations for sundry agricultural expenses" (Acts of 1900, chapter 31); "An act relative to the work of the Dairy Bureau of the State Board of Agriculture" (Acts of 1900, chapter 368); "An act making an appropriation for expenses in connection with the work of exterminating the gypsy moth" (Acts of 1900, chapter 403); "A resolve in favor of the Berkshire Agricultural Society" (Resolves of 1900, chapter 21); and "A resolve to authorize the State Board of Agriculture to collect and distribute information relative to partly abandoned farms and unremunerative lands" (Resolves of 1900, chapter 51).

ABANDONED FARMS.

Provision was made by chapter 51 of the Resolves of 1900 for carrying on the work of this office in "collecting and distributing information relative to partly abandoned farms and unremunerative lands." The resolve was approved April 11, and steps were at once taken to prepare material for a new edition of the descriptive catalogue.

The methods adopted were much the same as in former years. A circular letter was mailed the last of April to the assessors, but returns were received from only 147 of the 353 cities and towns. These communities reported 233 names, of which 195 were new, and from these 27 descriptions were received. Also a circular letter was mailed in June to some 70 individuals whom it was thought might be able to report names in their respective localities; but only 60 new names were received, resulting in 13 descriptions. It will be noted, therefore, that these efforts resulted in the getting of only 40 new descriptions. Circular letters were also sent to those having descriptions in the seventh edition, 206 farms, and the canvass resulted as follows: farms sold, 43; owners not wishing to advertise again, 15; owners wishing to advertise again, 70; no response, 78.

The new catalogue, eighth edition, contained 136 descriptions, and was issued the last of September. The average

acreage of these farms was 135.36 acres, and the average price asked $1,720.62.

The new catalogue was desired because of continual demand for information, both by letter and by person. The seventh edition of the catalogue was received from the printers in January, 1898, and after fifteen months scarcely any of the 1,500 copies issued were available for distribution. In order to ascertain if there really was warrant for asking the Legislature for a further appropriation to continue the work, a record was kept of the calls by mail during the calendar year ending Aug. 20, 1900. The record showed 252 such calls; 145 being from Massachusetts, 37 from New York, 13 from Connecticut, and the rest scattering.

An interesting feature of the new catalogue was the printing of replies of a number of purchasers of farms advertised in previous catalogues in response to a circular letter of inquiry. Details cannot well be given in this brief résumé, and it will no doubt suffice to say that nearly all of the parties responding to the circular letter gave their reasons for purchasing, and expressed themselves as satisfied with their purchase. There were also included in the catalogue several pages of statistics of Massachusetts agriculture compiled from the State census of 1895, they showing plainly that, while there had been changes in our agriculture, owing to changed conditions, there were no reasons for alarm, but reasons rather for congratulations at the good showing made. It might properly be said in this connection that the extreme difficulty this office has had the past ten years in getting descriptions of farm property for the several catalogues does not indicate that owners of farms are over-anxious to dispose of their property.

The reasons assigned by the 136 individuals desiring descriptions of their property included in the eighth edition of the catalogue may be summed up as follows: in other business, living elsewhere, no use for it or unable to carry it on, 67; old age, 22; poor health, 13; having another farm, 10; to settle an estate, 8; reasons not given, 16. In no instance was there any expression of dissatisfaction with farm life, or of the opinion that "farming doesn't pay."

The original act authorizing the State Board of Agriculture to undertake this work was approved May 4, 1891. A summary of the work to Jan. 1, 1901, is as follows: —

Number of all farms in State, census of 1885, . .	45,010
Names of owners or agents given by assessors, . .	1,371
Names of owners or agents received from other sources,	822
Total number of names furnished (duplications eliminated), ...	2,193
Number making reply to request for description, . .	995
Number of descriptions received, ...	711
Number stating they did not wish to sell, . . .	174
Number reporting property already disposed of, . .	60
Number stating informant to have been misinformed, .	50
Catalogued farms reported sold, ...	309
Catalogued farms withdrawn at request of owners, .	114
Catalogued farms withdrawn from later editions because owners failed to respond to letters of inquiry, . .	142

In regard to residence of the 309 purchasers at the time of purchase, the following is shown: Massachusetts, 178; New York and Connecticut, 14; New Hampshire, 5; Vermont and Rhode Island, 4; Ohio, New Jersey and Florida, 3; Nova Scotia, Maine, Indiana, Illinois, Wisconsin and Kansas, 1; not reported, 75. Judging by the names a large proportion of these purchasers were of American parentage.

In regard to the probable use which the purchasers intended to make of the farms purchased, the returns show the following: for farming purposes, 120; for a home, 26; for an investment, 15; for the wood and timber, 15; for summer residence, 13; for poultry with some farming, 10; for dairying, 9; for poultry, 7; for sheep, 3; for cranberry growing, 1. No statement was received concerning 90 of the farms reported sold.

Catalogues issued.

Edition.	Date of Issue.	Number of Copies.	Total Descriptions published.	Total Farms sold.	Total Farms withdrawn.
First, . . .	Nov., 1891,	3,000	330	-	-
Second, . . .	Jan., 1892,	1,500	339	-	-
Third, . . .	Nov., 1892,	2,000	383	51	22
Fourth, . . .	Nov., 1893,	2,000	400	108	53
Fifth, . . .	Dec., 1894,	2,000	543	150	79
Fifth Supplement,	April, 1896,	1,000	560	150	79
Sixth, . . .	Dec., 1896,	2,000	621	242	95
Seventh, . .	Dec., 1897,	1,500	638	269	103
Eighth, . . .	Sept., 1900,	2,500	710	309	114

Financial Statement, 1891–1901.

Appropriations of 1891, 1893, 1896 and 1900, ...		$5,000 00
Reverted back to State treasury, because unused, . . .		1,230 95
Amount actually available, ...		$3,769 05
Printing 17,500 catalogues, 8 editions, 1 supplement,	$1,945 77	
Postage stamps for mailing catalogues and circulars,	670 00	
Special services members of the Board of Agriculture, ...	196 30	
Special envelopes for mailing catalogues, . .	170 82	
Printed circulars, ...	129 96	
Sundries, ...	5 50	
Available for work in 1901, ...	650 70	
		$3,769 05

A four-page leaflet, containing descriptions of 9 farms, received too late for incorporation in the catalogue, was issued December 1.

This department is largely in charge of Mr. Fowler.

Dairy Bureau.

The annual report of the Dairy Bureau to the Legislature will be found printed on pages 371–391 of this volume.

The personnel of the Bureau has been changed, owing to the decease of the chairman, Mr. D. A. Horton of Northampton. The resulting vacancy was filled by the appointment of Mr. F. W. Sargent of Amesbury.

Chapter 368 of the Acts of 1900 provides that "the State Board of Agriculture shall at its annual meeting elect a general agent of the Dairy Bureau, to assist the Bureau and to oversee, under its direction, the work prescribed in section 11 of chapter 412 of the Acts of 1891."

This provision of law supersedes the appointment by the Governor of "an assistant to the secretary of the Board of Agriculture, — to assist in the work prescribed in the eleventh section of this act."

This act was intended to promote more perfect unity in the work of the Dairy Bureau, that it might have an agent who would be virtually appointed by them to do the work as general agent, not independent of the Bureau and the Board by appointment of the Governor. The general agent to "assist the Bureau . . . under its direction" cannot be misconstrued as assistant secretary of the Board of Agriculture as to duties, and all misconception as to duties or title in correspondence or press reports is obviated. It establishes the direct control of the Dairy Bureau over its "general agent" and all other agents, and at the same time lessens the responsibility of the secretary, which is wise, because of his many duties. It is believed this act will prove of material value to the work of the Dairy Bureau and the best good of the Board.

Pan-American Exposition.

The Massachusetts Commissioners for the Pan-American Exposition communicated with the secretary of the Board relative to an agricultural exhibit at that exposition. The matter was laid before the executive committee of the Board with the commissioners present, and after discussion the executive committee appointed Pres. H. H. Goodell, Hon. Wm. R. Sessions and the secretary of the Board a committee with full power to act. This committee with the commissioners have been in perfect accord. We have visited the Massachusetts Agricultural College, and the college has

been called upon to prepare the agricultural and horticultural exhibit of Massachusetts for the Exposition. President Goodell says of this exhibit: —

It will be largely illustrative, and by comparison rather than by actual specimens. In horticulture there are five cases, illustrative of its progress during the last hundred years, containing colored models of original fruits and vegetables side by side with the latest and improved varieties. It is an object lesson of the simplest kind, but of the greatest educational value.

In botany are four exhibits: first, a dozen plates illustrating the structure and development of the nematode worms, so ruinous to the cucumbers, tomatoes and other crops grown under glass, and supplemented by plates showing the methods used for sterilizing the soil and thus killing the nematode foe; second, eighteen types mounted on glass in glycerine-gelatine of fungous diseases of Massachusetts, affecting the growth and perfection of the leaf; third, a series of diagrams showing (*a*) the influence of electricity upon plant growths and (*b*) the different kinds of apparatus used for electrically stimulating the germination of seed; fourth, a set of mounted sections of wood of some sixty specimens of the trees of Massachusetts. There are three sections, of the thinness of paper, of each specimen, one section being cut perpendicular, another tangential and a third radial, thus showing the grain of the wood from every part of the tree. Accompanying each set of three are two photographs, one of the tree in full foliage and the other bare and denuded of leaves.

In agriculture are a series of charts depicting graphically the acreage of Massachusetts cereals, root and other crops, compared with the acreage of the same crops in three or four of the great agricultural States of the Union, a second series comparing the dairy products, and a third the yield per acre, cost and value of the same. These charts cover a period of forty years, and are exceedingly valuable and instructive.

This exhibit will, we believe, be distinctive and instructive, an honor to the college and the State. It rests with the Board to continue this committee or make such provision as seems to it best for the completion of this work, that the commission may be able to consult with the Board on all questions that may arise relating to the proper presentation of the agricultural interests of Massachusetts at this great exposition.

Protection and Value of Insectivorous Birds.

The Board believes in the great, almost invaluable, services of the insectivorous birds, and therefore in the list of subjects at the last winter meeting we placed the subject of "Birds useful to agriculture" first in the list. Desiring definite data as to the value of birds as insect destroyers, we asked the ornithologist of the Board, Mr. E. H. Forbush, to give us reliable information on this point, and insert his report, as follows: —

Fletcher, the greatest of Canadian economic entomologists, has estimated that one-tenth of the value of all the agricultural products of the United States is yearly sacrificed to insects. Therefore, taking the figures of the last census, three hundred and eighty million dollars is thus wasted annually. In view of such statements as this from conservative authorities, any promising means of reducing this appalling waste should command the attention of intelligent agriculturists everywhere. In this connection it may be safely asserted that too much attention is paid to the possibilities of costly artificial remedies, such as mechanical appliances and mineral poisons, and not enough to the valuable and inexpensive services rendered by the natural enemies of insects, especially the birds. Birds fitted by nature to pursue and devour these pests are also blest with phenomenal appetites, and require an enormous quantity of insect food. A woodcock has been known, says Audubon, to eat its own weight of insects in a night. The number of caterpillars that certain birds have been observed to eat within an hour almost passes belief. The young of our smaller birds, reared as they are at a time when insects are multiplying, require a great amount of insect food. A young crow required 8 to 10 ounces of food daily to promote its growth. Digestion in young birds requires only half an hour to an hour and a half, and their stomachs must be filled often, lest they pine and die. A young robin fed by Professor Treadwell ate 41 per cent more than its own weight in worms in twelve hours, requiring this amount, or about its own weight in beef, daily for its sustenance. Professor Wood states that the daily food of the robin is equivalent to an earth worm 14 feet in length.

The young while they are in the nest, and later when they first take wing, require the same parental care. One hundred and twenty-five visits were made to a vireo's young in ten hours by the parent birds. Nearly 200 visits were made to the nest by a

pair of chipping sparrows in a day. Martins have been seen to make 312 visits to the nest in fourteen hours. Grosbeaks have been seen to make 436 visits to the nest in eleven hours, while wrens have made from 40 to 71 visits an hour. Most of these visits were made for the purpose of carrying insects to the young, and in many cases several insects were carried in the beak at one time. If such birds can be induced to breed in numbers on our farms, if they can be protected and attracted to the vicinity of growing crops, their services cannot fail to check the attacks of insects, and so add materially to the harvest.

In view of the value of these friends to the farmer, as thus set forth, should we not investigate and experiment to find how best we can attract useful birds to our farms, how increase the number of these birds, and also to find out, if we can, whether the use of insecticides is reducing their numbers? So valuable is their aid to the farmer, that this study may show the wisdom of an investigation of this subject for the benefit of the State. Birds may be considered the most valuable insect destroyers, costing nothing, but bringing beauty and joy and song to the country side and the country home.

Agricultural College.

The report of the examining committee of the Agricultural College will be found printed on pages 227–231 of this volume. The thirteenth annual report of the Hatch Experiment Station of the college is by law bound with the report of the secretary of the Board of Agriculture in this volume. Those desiring further details as to the scope of the college and experiment station are respectfully referred to the president, Dr. Henry H. Goodell, Amherst, Mass.

Cattle Commissioners.

The annual report of the Board of Cattle Commissioners is by law printed in the annual report of the secretary of the Board of Agriculture, and the report for 1900 will be found printed on pages 395–482 of this volume. The office of the commission is at 8 Beacon Street, Boston; Dr. Austin Peters, chairman.

Agricultural Directory.

A directory of the agricultural organizations in the Commonwealth, with officers for 1901, will be found printed on pages 493–511 of this volume. This directory is intended to be absolutely correct. Members of the Board, officers of societies, granges and farmers' clubs will confer a favor by sending notice of changes to this office as soon as they occur.

Farmers' National Congress.

The report of the delegates to the Farmers' National Congress at Colorado Springs, Col., Aug. 21–31, 1900, is by request included in this volume, and will be found printed on pages 236–244. It is interesting to note that the present president of the Congress is a Massachusetts gentleman, Capt. R. G. F. Candage of Brookline.

Revision of By-laws and Rules.

The matter of revision of the by-laws, rules, etc., of the Board has been taken under consideration by the committee on institutes, rules and legislation, acting jointly with the executive committee, and the results of their labors will be duly reported. It is understood that the commission on the revision of the Public Statutes will soon make their report, and for this reason it is suggested that the printing of the statute laws relating to the Board of Agriculture and to the agricultural societies, and the by-laws of the Board, rules, etc., be deferred until after the new statutes become available.

It is hoped that the codification or revision above referred to will remove some of the objectionable features in the laws as they now stand.

Library.

The library in the office of the secretary is becoming more and more appreciated and used. Attention is called to the report of the librarian, which will be found printed on page 234 of this volume.

Semi-centennial of the Board.

The Massachusetts State Board of Agriculture was established by chapter 142 of the Acts of 1852, which was approved by His Excellency Gov. Geo. S. Boutwell, April 21, 1852. The first meeting of the Board was held at the Council Chamber in Boston, July 22, 1852, with His Excellency Governor Boutwell as presiding officer, and the secretary of the Commonwealth, Hon. Amasa Walker, as secretary *pro tem.*

It will therefore be noted that the semi-centennial of the Board is fast approaching, and it is suggested that action be taken at this time to provide for the proper observance of this epoch in the Board's history.

Crop Conditions and Weather.

A summary of Massachusetts crop conditions and weather for 1900 is here appended.

J. W. STOCKWELL,
Secretary of the State Board of Agriculture.

Boston, January, 1901.

SUMMARY OF CROP CONDITIONS, 1900.

The season opened late, and the cold weather of May tended to still further retard vegetation. The frosts of the 10th and 11th of May did much damage to early vegetables and some damage to fruit. Pastures and mowings were generally in excellent condition. Fall seeding did not winter as well as usual, owing to the lack of snow-covering during the winter. The fruit bloom was the heaviest in years. The severe frosts of the 10th and 11th injured peaches and strawberries severely, plums and cherries to a lesser degree, and apples practically not at all. Insects did very little damage; spraying increasing, but not rapidly. There was a fair supply of good farm help. Wages averaged about $18 per month with board and about $1.25 per day without board. There was even less change than usual in the acreage of farm crops.

In June there was very little injury from insects. Cool weather held corn back, but it was otherwise in good condition. Haying was not generally begun, and the crop did not promise to be up to the average. Early potatoes showed a slight increase in acreage in eastern sections, and there was prospect of a good crop. Early market-garden crops, with the exception of asparagus, were about average as to yield and price. The supply of dairy products was about normal, with prices slightly increased. Pasturage was in good condition, though likely soon to need rain. Strawberries were far from a good crop, but the prices ruled high. Apples promised a good crop; peaches a light crop; pears fair and plums generally a light crop; cherries were a very poor crop, having suffered badly from frost.

No noticeable damage from insects was reported in July. Indian corn was generally in good condition, though perhaps a little late. Haying was completed, with from two-

thirds to three-fourths of a full crop; quality good and condition first class. The acreage of forage crops was considerably increased because of the short hay crop, and they were generally in fair condition. Market-garden crops were generally short, owing to drought; prices about as usual. Early potatoes were nearly a failure, owing to drought. Apples promised a good crop; pears fair; plums light; peaches light; quinces and grapes good. Pastures were in need of rain in all sections. Rye, oats and barley were generally good average crops.

At the end of August, Indian corn promised a fine crop in all except Essex, Middlesex and Barnstable counties, where it was somewhat off. Rowen was a light crop in all sections. Late potatoes were below the average, owing to drought. Blight was not general and there was little rot. Tobacco was generally an excellent crop, and cutting was practically completed at the end of the month. Apples promised a good crop; pears fair; peaches light; grapes good; cranberries light. Pastures were far from being in good condition, and cattle were fed at the barns in many sections. Oats and barley were below the average as to grain and straw. Poultry keeping was generally found profitable, but not enough attention is paid to it in most cases.

Indian corn in September was rather more than an average crop in western and central sections and rather less in eastern. The rowen crop was far below the normal, and in many sections was practically a failure. Fall feed was also far below the normal. Onions were less than an average crop. Potatoes were probably not over a two-thirds crop; little rot and quality good. The prospects for root crops were not flattering. Celery was a fairly good crop. Apples promised to give one of the largest crops on record, but the gale of the 12th took off from one-third to one-half of them. Little was done to utilize the windfalls, except for cider for vinegar making. Pears were a fair crop; plums light; peaches average; grapes a very good crop; cranberries little, if any, over half a crop.

The last of October root crops were reported to be about average in western and central sections; in eastern and south-eastern sections yields considerably below the average,

Potatoes appeared to be one of the poorest crops for years. Pastures and mowings were in good shape and fall feed unusually good, resulting in a greatly improved condition of farm stock. Much less than the usual amount of fall seeding was done, owing to the drought, and that put in was retarded in germination. The fall rains and warm weather pushed fall seeding along finely, and at the close of the season it was reported to be in good condition. With the exception of apples, prices for which were low on account of the large crop, prices of farm crops ranged rather higher than usual, due probably to the shortage caused in most crops by the drought. Of 149 replies to the question: "How have prices for crops raised for market compared with former years?" 89 correspondents spoke of prices as average, 54 as higher than usual and 6 as lower than usual. There was the usual difference of opinion as to which crops had been most profitable, as well as which had proved least profitable. It might be said, however, that 54 considered corn to have been among the most profitable crops; 46, hay or grass; 31, potatoes; 9, sweet corn; 7, apples; 7, tobacco; 5, asparagus; 5, tomatoes, etc. Seventy correspondents agreed that potatoes should be reckoned among the least profitable crops; 28, apples; 17, hay or grass; 8, corn; 7, onions; 4, cabbages, etc.

The season was not one which could be called generally profitable for our farmers. The prolonged drought of summer and early fall cut many crops short to such an extent that the increased prices received failed to make up the shortage. Starting the summer with empty barns, the short hay crop and scanty pasturage materially increased the cost of producing dairy products. Of 144 correspondents answering the question as to the profits of the season, 43 regarded it as profitable, 17 as average, 26 as fairly profitable and 58 that it had not been a profitable one.

Massachusetts Weather, 1900.

[Compiled from data furnished by the Weather Bureau, Boston.]

January was milder than usual, the temperature ranging from 1° to 4° above the normal at all stations of official observation. The month opened with a general snow-storm,

which furnished the greater portion of the snowfall for the period and the first amount of consequence of the season. While the total snowfall for the month was less than the average, the precipitation, snow and rain combined, was in excess of the normal by about a half inch. There was an average amount of sunshine. The average number of days with .01 inch or more precipitation was 10.

February was distinguished by much unpleasant weather and more than the average amount of precipitation. The average number of days with rain or snow, 10, was the same as for the preceding month. The average precipitation was, however, far in excess of that of January, and about 4 inches above the normal. Excepting rain in southern coast sections, the precipitation was chiefly in the form of snow. The monthly mean temperature, 27°, was above the normal for February. The coldest weather of the season occurred during the month.

March was notable for a preponderance of fine, clear weather, the average number of clear days, 15, being much in excess of the pleasant weather usually experienced during this month. There was an average of only 8 days with a measurable amount of precipitation, which is a remarkable occurrence for March weather. Notwithstanding the small number of foul days, the average precipitation for the month was fully up to normal, and for the greater portion of the State it was from 1 to 2 inches in excess. It occurred, however, principally during two storms, *i.e.*, 1st–2d and the 16th. The month was colder than usual, the monthly mean temperature being about 1.5° below the normal.

April was a pleasant month, with more than the average amount of fair weather. There were 12 sunny days, 7 with skies partially obscured and 9 with general cloudiness. The precipitation was deficient, the average amount for the month being about 1 inch below the normal. Snow flurries were of occurrence in parts of the State, but the amounts too small to measure. The temperature was fairly well distributed through the month. The monthly mean was 1° above the normal for April. The temperature fell below freezing during the month at all stations.

May, as a whole, was a very unpleasant month. There

was much more than the usual amount of cloudiness, and very few days when the sky was wholly unobscured. The rainfall was also considerably in excess of the normal amount for the month. This was, however, fairly well distributed through the period. There was a general storm on the 3d, during which rain fell in about all sections of the State. The amounts were very large in coast sections. General moderate showers occurred on the 8th and 9th. A "spell" of unsettled conditions prevailed from the 15th to the 21st, during which there were showers on each day in parts or the whole of the State. The rainfall during the 19th was generally heavy. The average temperature for the month was considerably below the normal, the daily deficiency amounting to about 1° per day. With the exception of an unusually warm day on the 15th, when the mercury rose to 93° at Boston, the temperature was uniformly cool. Killing frosts were of general occurrence on the 10th and 11th, and in many localities where the conditions were favorable, thin ice formed. The lowest temperature recorded at Boston was 33°, on the 11th. With two exceptions, May 3, 1874, when the temperature was 32°, and again on the 3d in 1881, when it fell to 31°, the 15th of the month was the coldest in the past twenty-eight years at Boston. The month was marked by a prevalence of easterly and northerly winds.

June opened with warm weather, the average temperature for the first two or three days ranging above the normal of the season. This was followed during the latter part of the first week by one or two cool days. Showers, timely and well distributed, afforded sufficient moisture. The second week of the month was continuously warm. The temperature, however, was not excessive, and the maximum did not exceed 90°. There was much sunshine during this period, with an average of four clear days. The rainfall was light, in the form of showers, which fell chiefly on the 8th and 9th. There was a continuation of fine weather through the third week, with cloudless skies on an average of three to four days. The rainfall was light, although it was well distributed over the State. There was no marked change in the temperature, which ranged near the average for the season; it was, however, slightly lower than for the

preceding week. The closing week of the month was devoid of unusual features. The precipitation was deficient and irregularly distributed. Excepting in coast sections, where copious local showers were reported on the 23d, the rainfall was light.

The month of July was characterized by varied and extreme conditions of weather. The opening days, and until the 6th, the temperature averaged from 2° to 5° below normal. During this period there was much cloudiness, although the rainfall was light, averaging about .4 inch. The second and third weeks were excessively warm, the mercury being almost continuously above the normal. The warm wave was most intense from the 16th to 18th inclusive, during which the maxima temperatures ranged in the 90s, occasionally reaching 100°, in the shade, and the minima falling but slightly, if any, below 80°. The weather in the mean time was clear to partly cloudy, with a general deficiency of rain. The only showers of consequence were on the 12th and 18th. These were very irregular in amounts and distribution. A season of cool weather obtained from the 20th to 22d, with the maximum temperatures in the 80s. This was followed by a few days of moderate summer heat, resulting in a general rain storm on the 25th and 26th. The rainfall during this storm was generally copious. The month closed with several days of fair weather, with the average amount of sunshine and temperatures ranging near the seasonal average.

August opened with a "spell" of clear weather and cool nights, which continued through the 5th. In favorable localities the temperature fell dangerously near the frost point. The cool wave broke the record for August for many years past, variously estimated from ten to twenty-five years. This was followed by a period of warm weather with a high per cent of moisture. The mercury ranged in the 90's in all sections except those of the immediate coast. There were frequent showers from the 6th to the 10th, with the rainfall generally in light to moderate amounts. Three days of generally fair and cooler weather followed, with much easterly wind, and fogs were prevalent in coast sections. The third week of the month was characterized by

much cloudiness and rain. The storm of the 15th was quite general, giving copious rainfalls in nearly all parts of the State. During no week of the season was there so much precipitation. Comparatively low temperature accompanied the foul weather. The weather for the remainder of the month was generally fair, the exceptions consisting of local storms, usually attended by thunder and light rainfall. From the 20th to the 23d a moderate cool wave prevailed, and this was followed by several of the warmest days of the season. The highest temperatures of the season were recorded from the 25th to the 27th, when the figures ranged from 90° to 110°. The weather of August, as a whole, did not depart greatly from the average for this month.

The weather of September was characterized by a high average temperature, more than the usual number of clear days and rainfall above the normal for the month. While the temperature was in excess of that usually experienced in this month, it was so equitably distributed as not to impress the casual observer as being more than the average. There were no excessively warm days. The highest temperature registered at the office of the Weather Bureau, Boston, was only 91°, and only on two days. The minimum temperature, however, ranged unusually and continuously high. With slight exceptions it ranged in the 50's and 60's throughout the month, at Boston. In the interior and western portions of the State the mercury ranged much lower than in coast sections. The coolest period was from the 18th to the 20th, when frost occurred in many localities, and in a few instances, where the conditions were especially favorable, thin ice formed. The closing days of the month were cool. Notwithstanding the fact that the average precipitation was considerably in excess of the normal of the month, there were more than the usual number of clear days, and the per cent of sunshine was also in excess of the average. The rainfall was chiefly the result of two general storms, during which the precipitation was very heavy. At Boston 3.70 inches of water fell from the 16th to the 18th inclusive, which is an inch in excess of the normal rainfall of September at that point. The severe wind storm of the 12th was a conspicuous

feature of the weather of the month. The gale was general, and continued through a large portion of the day. It attained a velocity at Boston of 60 miles per hour, reaching its greatest force in the eastern parts of the State.

October was remarkably pleasant. There was about the average number of days with rain, the amount of which was fairly well distributed throughout the several sections of the State. Excepting the heavy fall of the night of the 8th, the storms were moderate. There was a week of overcast skies, from the 6th to the 12th of the month, but for the remainder of the period the days of sunshine and cloudiness were about equally divided. The weather was abnormally warm, viewing from a point of mean temperature, the daily means at Boston being in excess of the normal for two-thirds of the days. The mercury ranged higher in this month in the twenty-eight years covered by the national meteorological observations, but only in the early days of the month. The month was remarkable for a continuous moderate temperature and for the period in the later part of the month with a maxima of near 80° for several days. At Boston the maximum rose to 77° on the 22d and to 80° on the 23d and the 24th. This record is not paralleled in October at this station during the past twenty-eight years of official records. Killing frosts and occasional freezing temperatures were of occurrence from the 16th to the 22d, but excepting these days there was a general absence of frost. Fogs were prevalent in coast sections during the closing week of the month. There were no unusual features shown in the records of wind direction and velocity or those of air pressure. October, 1900, as a whole, will be remembered and will go on record as a month of most pleasant weather.

The weather during November was characterized by much cloudiness, the skies being wholly overcast during 15 days of the period. Sunshine predominated during 8 days, and partly cloudy weather for the remainder of the month. Precipitation occurred on an average of 12 days, and the monthly amounts were excessive at about all points or stations of observation. The monthly average for the State was 5.06 inches, which is slightly more than an inch above the normal for November. It was chiefly in the form of rain,

although snow fell in all sections at some time during the month. The largest amount for the month, so far as officially reported, was at Pittsfield, where 6 inches fell, on the 9th. The depth there, particularly in country roads, was sufficient to impede travel. A severe ice storm occurred in the vicinity of Leeds, which did much damage to fruit trees. The month was marked by abnormally high monthly mean temperature. The mean for the State was 42.7°, which is about 2° in excess of the normal. The month as a whole was one of much unpleasant weather, and generally unfavorable to outdoor work.

The weather of December was also made up of much cloudiness. The month was, however, conspicuous for few stormy days, and for a marked deficiency in the average precipitation. Snow or rain occurred, in measurable amounts, on an average of but 6 days, and the average monthly amount for the State was 2.06 inches, which is about 1 inch less than the normal. The snowfall was unusually light, the largest amount for the month being 6 inches at Pittsfield. The chief disturbance of the month was the storm from the 3d to the 5th. It was of southern origin, and moved northward along the coast. It was attended by winds of hurricane force, which were destructive to life and to property. The temperature record for December, viewed as a whole, shows the weather to have been less severe than usual. When examined in detail, however, it is found that for a period of 10 days to a fortnight, embraced in the second and third decades, there was much cold weather. The monthly mean for the State was 3.4°, which is 1° below the normal. Generally speaking, the weather was fairly representative of the first winter month.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

Annual Summary for 1900.

Pressure (in Inches).

Maximum reduced to freezing, 30.42, February 28, 7 A.M.
Minimum reduced to freezing, 28.55, February 25, 4 A.M.
Maximum reduced to freezing and sea level, 30.75, February 28, 7 A.M.
Minimum reduced to freezing and sea level, 28.86, February 25, 4 A.M.
Mean reduced to freezing and sea level, 29.985.
Annual range, 1.89.

*Air Temperature (in Degrees F.).**

Highest, 96.0, August 6, 5.30 P.M.
Lowest, — 8.0, February 3, 6.30 A.M.
Mean, 48.3.
Mean of means of max. and min., 48.1.
Mean sensible (wet bulb), 45.0.
Annual range, 104.0.
Highest mean daily, 84.0, July 17.
Lowest mean daily, 3.4, February 2.
Mean maximum, 59.1.
Mean minimum, 37.3.
Mean daily range, 21.8.
Greatest daily range, 47.5, May 27.
Least daily range, 2.5, May 19.

Humidity.

Mean dew point, 39.2.
Mean force of vapor, .436.
Mean relative humidity, 72.3.

Wind.—Prevailing Direction West. Summary (Per Cent).

North-west, 15.
North, 12.
South-west, 11.
South, 10.
West, 10.
Other directions, 42.
Total movement, 50,503 miles.
Greatest daily movement, 435 miles, February 26.
Least daily movement, 1 mile, November 29.
Mean daily movement, 138.4 miles.
Mean hourly velocity, 5.8 miles.
Maximum pressure, per square foot, 30.5 pounds = 78 miles per hour, February 25, 11 P.M., W.N.W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 51.67.
Number of days on which .01 or more rain or melted snow fell, 131.
Snow total, in inches, 37.0.

Weather.

Mean cloudiness observed, 55 per cent.
Total cloudiness recorded by sun thermometer, 2,238 hours = 50 per cent.
Number of clear days, 83.
Number of fair days, 144.
Number of cloudy days, 138.

Bright Sunshine.

Number of hours recorded, 2,216 = 50 per cent.

Dates of Frosts.

Last, May 29.
First, September 15.

Dates of Snow.

Last, April 9.
First, November 9.
Total days of sleighing, 27.

Gales of 50 or More Miles per Hour.

January 26, 64 miles, N.W.; January 27, 55 miles, N.W.; February 5, 53 miles, N.; February 13, 55 miles, N.W.; February 14, 50 miles, N.W.; February 22, 52 miles, N.E.; February 25, 78 miles, W.N.W.; February 26, 51 miles, N.W.; March 2, 57 miles, N.W.; March 4, 58 miles, N.W.; April 1, 50 miles, W.N.W.; April 26, 51 miles, N.N.E.; May 1, 52 miles, N.W.; May 5, 66 miles, N.W.; June 30, 50 miles, N.W.; July 7, 68 miles, S.W.; August 6, 57 miles, N.N.W.; September 12, 60 miles, S.W.; November 9, 58 miles, N.N.W.; November 10, 60 miles, N.N.W.; December 9, 51 miles, S.S.W.

* Temperature in ground shelter.

MEETINGS OF THE EXECUTIVE COMMITTEE

OF THE

BOARD OF AGRICULTURE,

1900.

MEETINGS OF THE EXECUTIVE COMMITTEE,

ACTING FOR THE BOARD.

BOSTON, Jan. 24, 1900.

The credentials of Hon. Wm. R. Sessions and Gen. Francis H. Appleton as members of the Board of Agriculture by appointment of the Governor were presented and accepted.

The matter of the delinquencies of certain societies in making required returns, referred to the executive committee at the annual meeting, was considered, and they were all excused except the Blackstone Valley and Middlesex North societies, whose cases were laid over until the next meeting of the committee.

The matter of filling the office of first vice-president, referred to the committee at the annual meeting, being in order, a ballot was taken, and Hon. Wm. R. Sessions was unanimously elected.

The matter of filling the vacancy on the committee on gypsy moth, birds and insects, referred to the committee at the annual meeting, being in order, a ballot was taken, and Hon. Wm. R. Sessions was unanimously elected.

The matter of change of date for the holding of the fair of the Bristol County Agricultural Society being under consideration, it was

Voted, That the request of the society for change of date be denied, and that the secretary notify the society of the action of the committee.

The matter of change of date for the holding of the fair of the Middlesex South Agricultural Society being under consideration, it was

Voted, That the date for the commencement of the fair of the Middlesex South Agricultural Society be changed to the third Tuesday after the first Monday in September.

The secretary presented a proposed bill for an appropriation for carrying forward the work of the office in the matter of repopulating abandoned or partly abandoned farms, which proposed bill was approved by the committee.

The secretary presented a proposed amendment to chapter 412 of the Acts of 1891, which proposed amendment was approved by the committee.

A request that the State pay for lectures and expenses of two speakers at any all-day institute was considered by the committee, and was denied.

The matter of changes in the by-laws and rules of the Board was considered, and action was postponed to a future meeting. While this matter was being considered, Messrs. Barton and Comins of the committee on institutes, rules and legislation, sat with the executive committee.

BOSTON, March 13, 1900.

Voted, To excuse the delinquencies of the Blackstone Valley and Middlesex North societies, they having filed their transactions for 1899 since the last meeting of the executive committee.

Suggestion was made that by imposing a fine societies might be more careful to avoid being delinquent in making required returns.

The request of the Hoosac Valley Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a special meeting of the society, on Feb. 24,

1900, "authorizing the officers to mortgage their grounds for the sum of $10,000, to pay existing indebtedness," being in order, the matter was considered.

There was presented a certified copy of the records of the meeting, showing that it was legally called and that the vote was passed by the necessary two-thirds; also advertisements of the hearing and of the call for the special meeting. The delegate from the said society also appeared in the interests of the request for approval.

No person appearing in opposition, it was

Voted, To approve for the Board of Agriculture the above-quoted vote of the Hoosac Valley Agricultural Society, in accordance with the provisions of chapter 274, Acts of 1890.

The request of the Middlesex North Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a special meeting of the society, Dec. 27, 1899, "That Sidney Drewett be and hereby is authorized and empowered, as treasurer of the Middlesex North Agricultural Society, to borrow in its name and behalf, at his discretion, a sum not exceeding $2,500, for the use of said society, for such time and upon such terms as he may deem advisable, the rate of interest not to exceed five per cent per annum, payable semi-annually, and therefor to sign and give the promissory note of said society; and also that Henry S. Perham as president and the said Sidney Drewett as treasurer of the society be and hereby are authorized and empowered, in its name and behalf, to make, execute and acknowledge a mortgage deed with power of sale in the usual form, and affix thereto the seal of said society, and such deed to deliver as security for the payment of said note, therein and thereby conveying, subject to an existing mortgage from said society to the Lowell Institution for Savings for the principal sum of $9,000, dated Jan. 23, A.D. 1896, all the real estate belonging to said society, situate on the easterly side of said Gorham Street in said Lowell, known as the fair grounds, together with any land theretofore acquired by the said society from the Lowell bleachery and situated on the southerly side of the fair grounds and to

become a part thereof;" and of its vote, passed at an adjourned special meeting of the society, on Feb. 5, 1900, "That Sidney Drewett be, and he hereby is, authorized and empowered, as treasurer of the Middlesex North Agricultural Society, to borrow in its name and behalf at his discretion, a sum not exceeding $4,800, for the use of said society, for such time and upon such terms as he may deem desirable, the rate of interest not to exceed five per cent per annum, payable semi-annually, and therefor to sign and give the promissory note of said society; and also that Henry S. Perham as president and the said Sidney Drewett as treasurer of the society, be and hereby are authorized and empowered, in its name and behalf, to make, execute and acknowledge a mortgage deed with power of sale in the usual form, and affix thereunto the seal of said society, and such deed to deliver as security for the payment of said note, therein and thereby conveying, subject to an existing mortgage from said society to the Lowell Institution for Savings, for the principal sum of $9,000, dated Jan. 23, 1896, all the real estate belonging to said society, situate on the easterly side of Gorham Street in said Lowell, known as the fair grounds, together with any land theretofore acquired by said society from the Lowell bleachery, and situated on the southerly side of the fair grounds, and to become a part thereof," being in order, the matter was considered.

There were presented certified copies of the above-quoted proceedings of the society, showing that the meetings were legally called and that the votes were the necessary two-thirds; also copies of the advertisements of the special meetings of the society and of the hearing by the Board of Agriculture. Certain persons appeared in favor of the request for approval, and certain persons appeared in opposition. After a full hearing and careful weighing of the evidence *pro* and *con*, the committee unanimously

Voted, To approve for the Board of Agriculture the above-quoted votes of the Middlesex North Agricultural Society, in accordance with the provisions of chapter 274, Acts of 1890.

Voted, That hereafter votes of societies on matters of

sale or mortgage of their real estate must be by aye and nay, and that the societies be so notified.

Voted, That the secretary ask the opinion of the Attorney-General as to the powers of the Board of Agriculture under chapter 274, Acts of 1890.

BOSTON, July 12, 1900.

Voted, That the action of the Dairy Bureau, in employing Mr. Geo. M. Whitaker as general agent, temporarily, until the next annual meeting of the Board, be approved.

Voted, That the first and second vice-presidents of the Board, the chairman of the executive committee, the president of the Massachusetts Agricultural College and the secretary of the Board be appointed a committee of the Board, to represent the claims of the agriculture of the State before the commissioners on the exhibit of the State at the Pan-American Exposition at Buffalo, N. Y., in 1901, and to have full powers in the disposition of any monies which may be devoted to the agricultural exhibit.

Voted, That the action of the secretary in regard to the Marshfield field meeting be approved.

MARSHFIELD, Sept. 4, 1900.

The executive committee this day authorized the Plymouth County Agricultural Society, on its request, to unite with the Marshfield Agricultural and Horticultural Society in the holding of its 1900 fair; and the dates of the Plymouth County Society were changed accordingly, — *i.e.*, to September 19, 20 and 21.

BOSTON, Oct. 30, 1900.

The executive committee, sitting jointly with the committee on institutes, rules and legislation, considered and acted upon the revision of the by-laws, rules and recommendations of the Board, and the matter was left subject to the approval of the Board.

SPECIAL MEETINGS

OF THE

BOARD OF AGRICULTURE,

1900.

SPECIAL MEETINGS OF THE BOARD OF AGRICULTURE.

Field Meeting.

Marshfield, Sept. 4, 1900.

A field meeting of the Board of Agriculture was held at the Daniel Webster farm, in Marshfield, this day, on invitation of Mr. Walton Hall, the present owner of the farm and a former member of this Board. Some twenty-five members of the Board were present, also several former members, officers of the Marshfield Agricultural and Horticultural Society and friends, — in all, a company of some one hundred persons. The gathering was quite informal, and the time was spent in inspecting the farm, peach orchards, cranberry meadows, etc., and in enjoying a clam-bake and dinner on the grounds.

The after-dinner exercises were presided over by First Vice-President Wm. R. Sessions. Short addresses were made by a number of those present. It was expected that the Hon. James Wilson, Secretary of Agriculture, would be present and make a formal address, but he failed to appear. A vote of thanks was given Mr. Hall for his courtesy and hospitality.

Worcester, Dec. 4, 1900.

The Board of Agriculture met in Horticultural Hall, Worcester, this day, at 11.30 a.m., for business.

Present: First Vice-President Wm. R. Sessions, who presided, and Messrs. J. S. Appleton, Avery, Barrus, Barton, Benedict, Bowditch, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Damon, Danforth, Ellsworth, Gleason, Goodell, Goodspeed, Hersey, Howard, Jewett, Kilbourn, Lloyd, Pratt, Reed, Richardson, Sargent, Sigourney, Smith, Spooner, Stockwell, Thayer, Thurston and Whitmore.

The credential of Mr. Warren C. Jewett, member by appointment of the Governor to succeed Mr. D. A. Horton, was presented and accepted.

On motion of Secretary Stockwell,

Voted, That Messrs. Goodell, Sessions and Hersey be a committee to report resolutions at the annual meeting on the death of Messrs. Grinnell and Horton.

The hearing on the request of the Bristol County Agricultural Society for the approval by the Board of Agriculture of its vote, passed at a special meeting of the society, on Oct. 20, 1900, "To borrow $4,000 for the purpose of paying for the recent enlargement of its grand stand, and mortgage its real estate to secure said loan; and to renew the mortgage of its real estate now held by the Bristol County Savings Bank," being in order, the matter was heard. It appearing that the action of the society was according to law and properly advertised, and no person appearing in opposition to the request of the society, it was

Voted, That the Board of Agriculture approves of the vote of the Bristol County Agricultural Society, passed at a special meeting, Oct. 20, 1900, as above quoted, in accordance with the provisions of chapter 274, Acts of 1890.

Secretary Stockwell. The report of the gypsy moth committee, made to the Legislature in accordance with the law under which this committee is still acting, is subject to your approval here to-day. It is somewhat long, and I doubt if we have time to listen to it now.

Voted, To adjourn the business meeting to 9.30 A.M., Wednesday.

Worcester, Dec. 5, 1900.

The adjourned business meeting was called to order by Second Vice-President Pratt, who said: The hour has arrived to which the business meeting of the Board was adjourned. Before we listen to the report which Secretary Stockwell will present, Mr. Sargent has a resolution which he wishes to offer.

Mr. Sargent read the following: —

Whereas, The profits of the time-honored and legitimate industry of dairy husbandry are seriously menaced by the manufacture and sale of oleomargarine and butterine, which are made to imitate and intended to be sold as pure butter; and

Whereas, The annual sale of 90,000,000 pounds of imitation butter supplants the product of 600,000 cows; and

Whereas, The Grout bill now before Congress is intended to suppress the manufacture of these products when colored yellow to imitate butter, by a tax of ten cents per pound; therefore,

Resolved, That it is the sense of this meeting that the Grout bill should become a law.

Resolved, That the Senators and Representatives in Congress from Massachusetts are urged to give their votes and active support and use their ablest efforts to secure the passage of the Grout bill.

Resolved, That a copy of these resolutions be sent by the secretary to each Senator and member of Congress from Massachusetts.

Mr. W. B. Barton (of Dalton). I move the adoption of the resolutions.

Voted, To adopt the resolutions.

The Chairman. If you will give your attention, Mr. Stockwell will present the report of the gypsy moth committee.

Report read.

The Chairman. The report is before you for your action.

Mr. Thurston (of Swansea). In view of the importance of the report, and the hour having arrived for the morning lecture, I move that the discussion or adoption of this report be left to the close of the afternoon session.

Voted, To adjourn the business meeting until the close of the afternoon session.

The business meeting was resumed at 4.30 p.m., First Vice-President Sessions presiding.

The Chairman. The business before you is the report of the gypsy moth committee, read to you this morning. The question now is on its acceptance.

Mr. Barton. I move that the committee's report be accepted and adopted.

The motion was seconded, and, after remarks by Messrs. Thurston, Ellsworth, Comins, Kilbourn, Howard, Whitmore, Reed, Pratt, Avery, Carpenter, Bursley, Sargent, Barton, Secretary Stockwell and the Chair, a motion to postpone action until the annual meeting having been lost, the report of the committee was unanimously accepted and adopted.

Adjourned.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

WORCESTER.

DECEMBER 4, 5 AND 6, 1900.

PUBLIC WINTER MEETING OF THE BOARD,

AT WORCESTER.

The annual public winter meeting of the Board for lectures and discussions was held in Horticultural Hall, Worcester, on Tuesday, Wednesday and Thursday, December 4, 5 and 6. The weather conditions were unfavorable the first two days, but the meeting was generally considered a very profitable one.

The opening session was called to order by Secretary Stockwell, who said: The hour to which this meeting was called has arrived. Prayer will be offered by Rev. Dr. Scott.

Prayer by Dr. Scott.

Secretary Stockwell. I now have the honor of introducing to you a farmer boy from Charlton, the mayor of this city of Worcester. His Honor Mayor Dodge will give an address of welcome to this city for our annual meeting.

Mayor Dodge. As I am called upon to address the various bodies which meet within the borders of our city, one of the first things I have to do is to find some apology for addressing the body of people. I cannot, perhaps, claim any distinctive right to talk to the farming interests, but I can console myself with the fact that I have as good a right to be here as Dr. Scott. I am as good a farmer as he is, I can hold a plow as well as he can, and I think I can pitch more hay. I had years ago some little genuine claim, perhaps. I began my career in Worcester by driving a milk wagon from beyond Tatnuck into the city, and I would like to call your attention to the difference between the standard then and that of the present time. In those days there was no question about the standard of the milk. We had six or seven Jersey cows at the farm where I lived. I would not vouch for their pedigree, but at least I know we sold

Jersey milk from those cows, and no one ever questioned the fact but what it was Jersey milk.

You can see, if a man breaks away from the farm, what a downfall he may have, going from an honest farmer to a city politician. We find the same difficulty, I notice, in trying to impress the fact upon the farmers to-day that has always apparently attended the efforts of the people to convince farmers that they have the best occupation there is in the world. I have heard it repeated by all classes of men: office holders and bankers, merchants and every class in the professions and the businesses that we ever heard of, each and all have told the farmer that he is the happiest man living, engaged in the very best occupation. But somehow or other the intelligent farmer refuses to take that view of it, and still insists that it is hard work and poor pay which meets the efforts of the average farmer.

We have had our attention called to one phase of farming in New England, and that is the abandoned farms. That has two sides. It is rather depressing, I confess, to go through the country and see the abandoned farms, — the farms that are practically abandoned for agricultural purposes; and yet, after all, we should consider this phase of it, — while the land of New England is not all occupied to the extent it might be for agricultural purposes, it is there ready to receive the attention of the farmer when the time comes that there is sufficient demand for it, and it gives the opportunity for growth and expansion in that branch of New England life; it always furnishes and will furnish until it shall have been fully occupied, an opportunity for an increase of that industry.

What is more depressing to me than the fact that there are some farms unoccupied is the fact that I am afraid we must confess that after you get beyond the circle that is stimulated by the demands of a city or a large village you find, not abandoned farms in the sense that they are not inhabited, but have been abandoned by the neglect of the owner, and these places that were once the homes of vigorous farm life are going to decay. The buildings are not kept up, the land is not kept up, and there is a general appearance of inactivity. It is but one of the same things

touching your life that touches every branch of life, and it is not to be attributed at all to the decadence of the farming occupation. It has touched the shoe shop; it has touched the factory. There has been a great inclination on the part of the people, undoubtedly growing out of circumstances over which they have no control, to go to the cities and to the large villages, where they can have employment and certain things in life that they are unable to get in the more rural districts. It has touched every business, every branch of life, so that it is not alone the abandoned farm in New England, — it is the abandoned factory and the shop. The tide has flowed toward the centres of population; but the time will come when it will flow back, when the advantages of these places in the country towns will so over-balance the advantages in the more concentrated form of living that the tide will flow back again, and the factories will be occupied and the farms will be used.

You have met here in the centre of the county, in the place where almost all bodies as they are organized for their various purposes meet. You have a right to meet here. It is appropriate that you should come to this centre of population and the centre of the great industries of the county, because, however much we may pride ourselves on the great prosperity of Worcester and the phenomenal growth of Worcester, at the same time we recognize the fact that Worcester has drawn largely for her prosperity and her success from those towns that circle round about in the good old county of Worcester, and we shall never forget how much our farms have done for the city; we shall not forget that outside of the circle of very successful farmers in our city, making it prominent in its production of agricultural merchandise, — that outside of that in the towns throughout the whole county there is pouring into Worcester every year that vigorous manhood and womanhood which is founded and established by a sinewy life upon these farms in the hilltops and the valleys of good old Worcester County.

We bid you welcome to this prosperous and beautiful city, which is our pride and your pride; the centre of a virtuous and industrious people, the character of whom is

not excelled anywhere in the United States and equalled in very few places.

Agriculture in New England is not dead. It never will sink out of sight, however much there may be sent on by the carload from the West. There never will come a time when this interest in New England will drop out from among the important industries in this part of the country; and, contrary to the theory of some, there never will come a time when old New England will not be prominent in this industry. Notwithstanding all the advantages of the West in certain directions, they never can take the glory of New England away from the locality made historic and made successful by the intelligence and enterprise that will continue to abide here and will compare favorably with that which can be found or produced or cultivated in any other part of the United States. Let us have faith in New England; faith in Massachusetts; faith in the institutions which have been planted here and nourished by the greatest intelligence of the race, giving to each and all the encouragement due to the honest effort of the people of good old New England, and especially our own Bay State; and chief, of course, among all the cities of the State and chief among all the counties of the State we must be especially patriotic to the city of Worcester and to the county of Worcester, which has stood forth at all times prominent in the history of the State, and worthy of the attention of the thinking people that inhabit this part of the greatest country on the face of the earth.

The SECRETARY. In response to the inspiring address by the mayor of Worcester, we will listen to Hon. Wm. R. Sessions of Springfield, first vice-president of the Board, who will act as presiding officer at this meeting.

Mr. SESSIONS. It is my pleasant duty to respond to this address of welcome in behalf of the Board of Agriculture, with which I have been connected for the last twenty years and with which I am still identified. The mayor spoke of his experience as a milk peddler in the city of Worcester, and it brought to my mind a fact which a friend related to me. Some years ago, perhaps about the time when the mayor was driving a milk cart, this man was supplying milk

to certain families in Worcester. He was anxious to get the best trade. His milk was taken on trial by one of the wealthy families of the city. To make sure to please the family he selected the milk from the best cow, knowing, of course, which gave the richest milk. The next morning he asked how the milk suited. The servant girl said: "I am afraid it didn't suit very well; the mistress wants to see you." She came to the door, and he asked about the milk. The lady said: "I do not like that milk; it was all covered with a nasty yellow scum." I think perhaps that kind of people traded with the mayor. Since that time there has been a great advance in the taste and knowledge of the people of Worcester in regard to this prime article of food supply, so bountifully produced within the city of Worcester.

I do not wish to weary you with a long address. The Board of Agriculture has always looked upon Worcester County with as much appreciation as the mayor desires. Worcester County, you all know, stands, among some four or five of the counties of the country, first in the amount of agricultural products. I think it has stood as high as third in the United States of America, which is something wonderful, when we remember at the same time the enormous amount of manufactured products which this county produces from year to year.

I had occasion, in talking with a man who had come to Boston from the far west, and who had passed through Worcester County, to ask him what he thought of New England. He said: "If I have seen a sample of New England to-day, I do not want any of it. I could get more off a quarter-section of land in Dakota than from a whole county in New England." I asked him if he knew he had passed through a county that has only one or two superiors in the United States in the value of its agricultural products. He could not believe me, but it was a fact. That being the case, we need not feel that it is necessary for the agriculture of Massachusetts to take a back seat at all. The agriculture of this part of the country is different from that of the west or the south or the middle States. Its products will continue to increase in value, and those who follow

it will, I trust, continue to prosper. Those to whom the mayor referred as allowing their places to run down are farmers in name only. They are farmers because they were not enterprising enough to be anything else. Many and many a farm in Massachusetts and in New England is occupied by some son of an enterprising farmer, who had the least enterprise of any of the half-dozen boys who grew up on the farm. The enterprising ones went out to the city of Worcester, to Boston and to Lowell, and made a mark and a name for themselves. The one who had no gimp to get up and hoe his row was the one who stayed on the farm. The decadence of New England farms is more largely from that cause than any other. Many of the farms are occupied by the least enterprising son of the farmer, because he had the least enterprise. But where you find a farmer who loves his work and respects his calling you will find thrift, prosperity and happiness.

This Board which meets here to-day is an old Board; it is one of the oldest in the country. It was organized by act of the Legislature in 1852, and since that time, almost fifty years, it has been working for the advantage of agriculture. It has seen, largely through its efforts, a wondrous change in the agriculture of the State. If we were to compare the agriculture of 1852 with that of to-day, we would find a tremendous advance and improvement.

The Board has always had among its members men of the highest scientific attainments, of wide reputation, who had the respect of the community; men who were known throughout the United States, men of whom we were proud; and also among them have been men who have been successful and practical farmers; men who have made a success of the business of agriculture. These two classes have given wise counsel to the farmers of Massachusetts, instruction that has enabled them to succeed in business, and that has caused an improvement in agriculture from the time of the institution of this Board. I may mention a few of the men who have been members of the Board and prominent in this work: Charles L. Flint, Dr. Edward Hitchcock, Marshall P. Wilder, Simon Brown, James S. Grinnell, Robert C. Winthrop, Ephraim W. Bull, President Wm. S. Clark,

Dr. Jabez Fisher, Paoli Lathrop, Levi Stockbridge, Dr. Geo. B. Loring, John B. Moore, Asa Clement, Thomas Motley, Prof. Louis Agassiz, President Paul A. Chadbourne, Avery P. Slade, James F. C. Hyde, John T. Ellsworth, Richard Goodman, O. B. Hadwen, Thomas P. Root, Dr. Horace P. Wakefield, Charles S. Sargent, Ensign S. Kellogg, Henry S. Russell, Benjamin P. Ware, Dr. James R. Nichols, John E. Russell, E. Frank Bowditch, Dr. J. P. Lynde, Calvin L. Hartshorn, Merritt I. Wheeler, E. W. Wood, George Cruickshanks, Elbridge Cushman, W. W. Rawson, Geo. L. Clemence, Prof. N. S. Shaler, Wm. H. Bowker, J. D. W. French and Prof. Wm. P. Brooks.

These men I have selected out of the list of members of the Board of Agriculture, because of their connection with some particular branch of agriculture. Along with them we have Dr. C. A. Goessmann, who is still a member of this Board, after thirty years' service. There are many members of the present Board who are worthy of mention in this list. From the labors of these men, supplemented by the influence of the Agricultural College and the Experiment Station, have come largely the improvements and advances in agriculture in this State.

The plan of holding public winter meetings by this Board was inaugurated in 1863, and a meeting like this one has been held every year since, rotating from one county to another, that all the farmers might in turn have the advantage of a meeting of this kind. For these meetings the very best lecturers in the United States and Canada have been procured, without regard to expense. The lectures and discussions that followed have been printed each year in the volume "Agriculture of Massachusetts," and that book is printed at the State's expense for free distribution. One-half the edition is distributed by the Legislature, the other half by the secretary of the Board of Agriculture, through the agricultural societies, farmers' clubs, and by appointed agents in towns where they have no such society. An effort is made by the secretary that every farmer who desires shall have one of these reports; and he is always ready to supply one, on application, to any person who has failed to receive a copy through the regular channels.

There are forty-six of these reports, which in themselves make an agricultural library. There is not a single line of the whole series but what will interest some farmer and give him something for his special line of agriculture.

I have thus detailed one branch of the work of this old Board. If I were to take your time, I could detail other branches of it in which they have succeeded, but this is not the time or place for anything of that sort. The services of the members of the Board are gratuitous. No member of the Board has a salary except the secretary, and he is obliged to spend his whole time in the work, and thus has no other means of earning a livelihood.

This is the fourth time that this Board has held its public winter meeting in the city of Worcester. The meetings have been held in the different counties of the State, four having been held in Hampden County, three in Franklin, three in Essex, five in Middlesex, four in Hampshire, four in Berkshire, two in Bristol, two in Plymouth, one in Suffolk and ten in Worcester, including this meeting. This shows the appreciation the Board has of the county of Worcester and the city of Worcester.

The city of Worcester, as the mayor has told us, is an important part of the Commonwealth of Massachusetts. While it is the second city in the State in population, it stands first in agricultural products. Its milk, market-garden products and fruits, produced entirely for the home market, make Worcester the banner city for agriculture; while its diversified manufactures give employment to the thousands who consume these products of the farms and gardens within its limits. This makes the city of Worcester a typical place to illustrate the agriculture of New England to the rest of the country.

Fortunate are the farmers who live in this queen city of the old Bay State. The Board of Agriculture is happy to meet here and enjoy the hospitality of the city, the agricultural society, the horticultural society, the grange and the individual farmers of the county.

First Vice-President Sessions in the chair.

The Chairman. The next on the programme is an address of welcome on behalf of the Worcester Agricultural

Society, by Preisdent Wm. J. Hogg. This morning a letter has been received from the president of this society, saying that he will not be able to be here, because of a business call that takes him out of the city, and he has delegated Hon. H. S. Stockwell to give this address of welcome in his place.

Mr. Stockwell. In behalf of the Worcester Agricultural Society I tender to you our most hearty and sincere welcome. We welcome you to this city, to the heart of the Commonwealth, and to this agricultural society that has existed over eighty years, — nearly the whole of the nineteenth century. This has been a society for the promotion of agriculture. In looking over its history, we feel that there is no society in the Commonwealth that has done more for agriculture than the old Worcester Agricultural Society. It was organized in 1818. Its first president was Hon. Levi Lincoln; its first secretary was Mr. Wheeler; the present secretary is a descendant of our first secretary. It held its first agricultural fair on the grounds opposite where we are now located. It has been successful in all its undertakings, always paying all its bills, and has at the present time property valued at over $100,000. We have been fitting up grounds purchased some two or three years ago at an expense of some $70,000, and we have $50,000 at interest. We feel that this society has done a great deal for Worcester County in its agricultural interests. We feel, too, that this society is identified with the State Board of Agriculture. We have selected some of our best members to represent us upon the State Board; the State Board in return has come to this society for three of its secretaries, — Mr. Flint of Grafton, Mr. Russell of Leicester and Mr. Stockwell of Sutton. You can naturally see the fraternity that exists between this society and the members of the State Board, and we feel that it is fitting and proper that you should be with us at this time, upon the eve of the twentieth century, to look over the past with this old society that has lived almost through this century.

In speaking of Worcester County and its agricultural interests, I think the old Worcester Society has done more to inspire this county in its efforts for agriculture and has done

more to help it — and we stand in the foremost rank of any county in the United States in our agricultural products — than anything else. I think you may go where you will in the United States and you will not find a county that has such beautiful scenery, such magnificent farms so well tilled and cared for, and such a contented people as you find here in the heart of the Commonwealth.

Gentlemen, we are happy to welcome you here on this occasion. We hope that your stay with us will be most pleasant and profitable.

The CHAIRMAN. I have been informed, since I called on Mr. Stockwell, that he is the new president of the Worcester Agricultural Society. Since the programme was printed, he has been elected. We will listen to a response to the welcome of the Worcester Society, by Mr. Augustus Pratt, second vice-president of the Board.

Mr. PRATT. It has been my pleasure many times during my life to attend the agricultural fairs of the Worcester Agricultural Society. On all these visits I have received the same hearty welcome which has been extended to the Board of Agriculture to-day. Certainly the Worcester Agricultural Society is entitled to all the honor and credit that has been given it this morning. It was one of the earliest societies to receive the act of incorporation. I believe there are but three before it, — the old Massachusetts Society for the Promotion of Agriculture was incorporated in 1792, the Berkshire Agricultural Society was incorporated in 1811 and the Hampshire in 1814. These are the only three that started earlier than your society, Mr. President; and during these eighty-two years which this society has existed, I believe it has accomplished much good for the agriculture of Worcester County and other sections of the State. This society has reason to be proud of its record. It has truly been a successful society.

There was wisdom displayed by those men in early days in selecting the grounds for the fair. These grounds advanced rapidly in value, and have continued to increase in value each year until the day of the sale. If I remember correctly, your president, Mr. Ellsworth, ten years ago, in 1890, in addressing the State Board at their gathering here,

said that you had fair grounds valued at $125,000; and if I am rightly informed, within about eight years of that time you sold the grounds and received the sum of $185,000, — an advance of $60,000 in a little over eight years. I think there was wisdom displayed by the early managers of this society in selecting these valuable grounds. It does seem to me that you have done just the right thing in your sale. You have gone a little farther out of the city, and purchased an equally as good location for the purpose for which you wish to use it, at a much less price; and have had the opportunity, as your president has said this morning, to deposit $50,000 in the bank to draw from if you have a rainy day for the fair. Rainy days have been a great trial to the society with which I am connected. If after all our preparations a rainy day should set in at fair time, we would be financially embarrassed. You need have no such fears, with your $50,000 on deposit and the large rentage which you will receive from letting the grounds.

Through the courtesy of Mr. Ellsworth, I had the privilege a year ago at the time of the fair to look over your new purchase, and I certainly concluded that it was an excellent choice, a beautiful location, well adapted to the purpose for which you intend to use it. I am very glad to know that the Worcester Society stands on such a firm basis, that it is likely to continue to be a society to advance the cause of agriculture for many years.

I wish to say a few words more in regard to the State Board of Agriculture. I think these winter meetings, as has been said by Mr. Sessions, were established in 1863, Springfield holding the first meeting, Greenfield the second, and the Worcester Society, in the city of Worcester, being entitled to the honor of having the third of the winter meetings. It does seem to me, Mr. President, that your society has been the pioneer in all good things. These men who got together and established the winter meetings of the Board did not then anticipate, did not then know, the good that they were doing to the agriculture of Massachusetts. Yet certainly in the thirty-seven years which these meetings have continued from year to year, in different cities and different parts of the Commonwealth, they have been the

means of greatly advancing the cause of agriculture. They have been a source of instruction to the farmers throughout the Commonwealth.

I am happy to know that upon this platform is one of the gentlemen who was first in suggesting the farmers' institutes. He was then a member of the Board of Agriculture. Each society is now required to hold three of these institutes each year. I am happy to know that Mr. Hadwen was one of the members of the Board who urged and pushed this matter forward, to have the farmers' institutes held throughout the Commonwealth. I know these institutes have accomplished much good. I think that the papers of information that have been presented at these institutes have been the means of making better farmers in Massachusetts.

Another source of great good, I must say, to the agriculture of Massachusetts is the college. The valuable literature that is sent out each year and the competent instructors who come from the college each year to instruct the farmers have accomplished much.

I think, with all these helps, with all this source of instruction which we now have, that, as the mayor has told us this morning, the future is bright, that the agriculture of the future will advance. It does seem to me it cannot help it. We can with confidence look forward to a better state of agriculture for the coming years.

It is to be regretted that the young men during the past few years do not enter the agricultural life as readily and as freely as they do some other branch of life. They choose some other means of support. I believe that there is a good opening in agriculture. I believe the future of agriculture is to be brighter for young men than the past. I think that an agricultural life — and I speak from experience — is the life for happiness and for health. If there is any better life, I do not know it. Taking everything into consideration, health and everything else, I do not believe there is any better opening for a young man at the present time than to seek an agricultural education and assume an agricultural life.

I thank you, Mr. President, for the cordial welcome you have extended to the members of the Board of Agriculture

this morning. We are here with you for a few days, and we trust, in fact, we know, that we shall have a pleasant and enjoyable time.

The CHAIRMAN. The next on the programme is a welcome from the Worcester County Horticultural Society. You may all know that we meet in a hall owned by that society, that they tender to the Board of Agriculture gratuitously the use of this beautiful hall and its conveniences for this meeting. This society joined with the Worcester Agricultural Society in inviting the Board to meet here. It is one of the oldest horticultural societies in the State. It has done a wonderful work. Mr. O. B. Hadwen has been connected with it I do not know but from the very beginning. He will extend the welcome to the Board.

Mr. HADWEN. In behalf of the Worcester County Horticultural Society I tender you a most cordial and hearty welcome. I do this with greater pleasure, as twenty-four years have elapsed since I had the pleasure to extend to your Board a welcome from this very platform, to this our horticultural hall, the headquarters in this city of one of the important interests you have especially in keeping.

Great changes have taken place during this period of time. Agriculture and horticulture and their kindred callings have become more intense, new modes of cultivation have sprung up, new implements are used, new products are grown, to supply the wants of higher and better living.

We are a progressive people. The requirements of the day are study and work. The man who is unwilling to study and work will find he is superseded by knowledge with industry, and must go to the wall.

The study of the mechanics, the manufactures, the trades and of agriculture occupies the larger portion of our people, and they work out the practical results of many improvements with the aid of improved machines and implements. The man who would attempt to manufacture or to carry on his farm or garden on the conditions practised or pursued fifty or sixty years ago would certainly find he was pursuing an unprofitable business and being outstripped by his more thrifty neighbor.

Agriculture is yearly becoming more intensive. The

farmer must learn by what course of husbandry he and his farm can secure the greatest benefit to his family and at the same time enhance the value of his estate, that his productive industry must more than equal his increasing modes of living, that he must live equally well with those engaged in other pursuits.

Happily the era is fast passing away in which farmers, either rich or poor, in any section of our county, deem it incompatible with their interests and with the dignity of their vocation to live in homes deficient either in comforts or embellishments such as the age now demands.

I haven't time to speak fittingly of but few of the places of interest which surround us here. We all have a commendable pride in the city of our homes. At the beginning of the nineteenth century it contained 2,411 people. Within the lifetime of the speaker this place has grown from a town of 3,500 inhabitants to a city of 120,000, having a valuation of more than $112,000,000, with an annual productive industry of more than $45,000,000.

These vast results are not largely caused by inherited wealth, but by inherited brains and energy. We have not only learned to produce a dollar more but to earn our dollars better. With the increased facilities of the present day, our agriculture and horticulture, with their various phases, must compete with the whole country.

Worcester County, lying in the central portion of the State, traversing its entire width, compares favorably in respect to its fertility of soil with any county in the Commonwealth. The farming pursued here is usually termed mixed farming, the dairy being the most prominent and leading interest, together with all the cereals, fruits, roots and grasses that this latitude favors. Our farmers have taken advantage of information obtained from exhibitions of agricultural and horticultural societies, from institute meetings of agriculture and horticulture, and are well-trained producers of all the farm and garden products that an intelligent community demands.

It is especially gratifying to those of us who have had the privilege of watching the progress of agriculture for the past fifty or sixty years. While some call its progress slow,

I think its progress has denoted an energy fully equal to that of other callings. There are so many who have devoted their lives to the progress of agricultural pursuits; and when we recognize the fundamental truth that the ground we cultivate is the primary source of all wealth, and without the products of our industry all other industries would be paralyzed, we may justly feel proud of our calling, and continue to persevere.

The city of Worcester, comprising the original town of about five miles square, and having a great variety of active industries in various directions, together with the vast number of factories and buildings covering so large an area, still contains room for a large number of highly cultivated farms. The farm and garden products are equal to those of any town within the Commonwealth, and its live stock perhaps is in a corresponding ratio to its product. I learn from the books of the assessors as follows: there are kept within the city 5,411 horses, 1,708 cows and 240 other cattle, 425 swine, 49 sheep and 8,887 hens.

The location of this city, in the very midst of an agricultural and manufacturing region, with her system of steam and electric roads radiating in every direction, with her university and colleges, her polytechnic and normal schools, together with her vast system of public schools, her free public libraries, her Antiquarian Society and Society of Antiquity, with her public halls and buildings and her vast manufacturing plants, will compare favorably with any city of her size in the country. There is also within her limits a system of ten public parks, comprising more than four hundred acres, extending out from the centre in all directions, containing prominent natural and artificial features of landscape, and planted with all the deciduous and coniferous trees, with all the hardy flowering shrubs and plants adapted to this climate, and where every advantage is afforded to her citizens for rural outing and health-giving enjoyment.

Such in part and in brief is the city of Worcester, in which you are to-day assembled at the closing of the nineteenth century. To her hospitalities we again welcome you, and may the purpose of your coming be accomplished,

and may our lectures and discussions promote and improve the agriculture of the Commonwealth.

I have thus endeavored, gentlemen, to speak to you, let me hope not entirely inconsistent with the time and the spirit of the occasion, and for the honor of your presence we thank you.

The CHAIRMAN. I find by the programme that Mr. Ellsworth of the Worcester Agricultural Society will respond to this address of welcome. He is known to you, and I need not introduce him.

Mr. ELLSWORTH. On behalf of the State Board of Agriculture and also the Worcester Society, from which society I am a member of the Board of Agriculture, I wish to thank the president for his very kind words of welcome, and I wish to assure him that they are appreciated by the members of this Board.

I am aware of the fact that these addresses have taken considerable time. I have been very much interested, and I know of no speech that can better afford to be curtailed than mine. I had thought of a few things that I would mention, some of them in relation to the Board of Agriculture, but they have been well referred to by the president of the day and by other speakers.

There is one thing that comes to my mind at your meeting to-day, and that is the gradual and the quite wonderful change that takes place from time to time. As we look back we can see the changes, and some of us are not so very old, for all that. Changes here in Worcester have been gradually taking place from year to year. It is but a few years ago that land now occupied by city residences was used for raising crops for the markets of Worcester and elsewhere. I can well remember where cows were pastured and corn and potatoes grown, and now there are beautiful residences built on these places. We can see changes in the farming in Worcester. But a short time ago stock was raised, butter and cheese made, and beef and pork were raised for the market. Now the land is taken up with milk farms. Where the milk farms were formerly located, the places are occupied by farmers who raise early vegetables and fruit for the market. And I might continue to speak in this way.

Referring to the Board of Agriculture a moment, you can see by the annual reports that changes are taking place. I took down my large black books and looked over the addresses. Some of the first reports were mostly taken up in discussing the breeds of cattle, — the different breeds for milk, butter and beef, the care, etc., of the same; the raising of corn, roots, potatoes; subsoil plowing, irrigation. If you take down a volume of our last year's report you will see a great change. In that is the report of the chemist, the entomologist who treats of the insects, such as the gypsy moth and the San José scale, and other things we never heard of thirty years ago; we also find interesting accounts of experiments with special fertilizers.

I will not take more of your time. There are others to follow me.

I wish to again thank the president of the Horticultural Society, and through him the society, for the very cordial welcome we have had here to-day.

The CHAIRMAN. The next is a welcome from the State Grange. The headquarters of the grange are where the State master resides. The present State master is an honored citizen of Worcester. The Board will be delighted to hear from Mr. W. C. Jewett.

Mr. JEWETT. As a citizen of Worcester I am glad to welcome you to our city, of which we are so proud, — a city noted for its manufacturing interests. We probably have the largest variety of manufacturing of any city in the United States. A city, as you have heard to-day, noted for its agriculture, for its successful farmers. Every approach is guarded by a successful farmer. It makes the strongest bulwark that could be thrown around any city or nation. I wish to welcome you to this hall. More agricultural societies have been formed in it than in any hall in the United States, and its walls echo back the words of many men gone before us who were interested in the same work that we are to-day. I wish to welcome the Board of Agriculture and welcome your work, and I will promise to give any possible assistance to the Board in carrying out its work in increasing the interest in the farms in Massachusetts and in increasing our production.

I believe in every agricultural organization; I believe there is a work for them to do.

I believe the grange offers the best opportunities of any organization in the land. Why? Because it starts in the home; it brings to our wives and our children the same advantages and the same opportunities that it brings to the fathers, which is certainly doing away with the social and educational barrier that did exist and does exist in many farm homes to-day. We believe the social branch is doing a great work. It is bringing back the social position of the farmer where it was years ago, — the highest position in the land. We believe the educational advantages are making better men and women, better business men, better in every way to carry on the different walks of life.

I can hardly stop when I begin to talk of what the grange can do. I again welcome the Board of Agriculture, trusting that your meetings will be pleasant, and that the inspiration that goes out will lighten the burden of many farmers in this community.

The Chairman. The Massachusetts Board of Agriculture has representatives from all parts of the State, and the gentleman who is to reply to this address of welcome is from Cape Cod. You will see when he appears before you that Cape Cod can raise a likely specimen of a man, if it does not raise great crops of corn. Mr. Bursley, delegate from the Barnstable County Agricultural Society.

Mr. Bursley. As you have seen in the last hour, farmers love to talk; but, as well as liking to talk, they like to get pretty near the dinner table some time between twelve and one o'clock, and it is not my purpose to keep the farmers here. I know nothing but an interest in agriculture would have brought out a hundred people to the opening meeting of the Board of Agriculture. Therefore, I will simply thank you, as a representative of my own subordinate grange, the Old Colony Pomona Grange. I believe the day is not far distant when to be a patron will be considered a necessity for a man to be a member of the Board of Agriculture. The last appointment by His Excellency the Governor was in strong recognition of that fact, when he appointed our worthy master to our Board. I believe

we shall all work better and do more for the cause of agriculture in Massachusetts when we are connected with that order.

To-day the Board of Agriculture is doing its work; the college its work; and the grange, represented by over 13,000 people in this State and entering probably more than 5,000 homes, is broadening and extending the work and the good feeling among agricultural classes.

Mr. President and Worthy Master, we thank you, knowing that this meeting here cannot but be profitable for the Board, for the agriculture of Massachusetts and for the Order of Patrons of Husbandry, second only to the good that will be brought to pass in your gathering here next week.

The CHAIRMAN. This completes the programme for the public meeting this morning. The public meeting is, therefore, adjourned to 2 P.M.

AFTERNOON SESSION.

The meeting was called to order by Chairman Sessions, who said: I feel it a pleasure to introduce the speaker of the afternoon. He is a friend of mine. I have been associated with him for eight or nine years in public work. You know the old adage, "To know a man you must summer and winter him." I have summered and wintered this man for eight or nine years. He is an honorable man, is a man who knows his business, and a man on whose word you can depend. What he tells you about birds in Massachusetts you can depend upon as matters that he has himself investigated, and knows whereof he speaks.

The lecturer has requested me to say that the lecture will be given first and the slides later.

I have the pleasure of introducing Mr. E. H. Forbush, ornithologist to this Board, and a former president of the Worcester Natural History Society. He is well known in Worcester, and will now speak on "Birds useful to agriculture."

BIRDS USEFUL TO AGRICULTURE.*

BY E. H. FORBUSH, ORNITHOLOGIST TO THE BOARD.

Studies of the economies of nature show that in a wild country, *untroubled by civilized or semi-civilized man*, the interactions of nature's multitudinous organisms tend to preserve a finely adjusted balance of her forces, which furthers the survival and perpetuation of the best adapted forms of animal and vegetable life. In such a region, as elsewhere, certain of the higher animals feed on the lower, while some of the lower subsist on the higher. In the end, however, both vegetables and animals, while continually at war, flourish, wax strong and perpetuate their kind. There birds, mammals and insects, although filling important places in the economy of nature, cannot be classed as beneficial or injurious, for there is no agriculture. Introduce primitive man into a country like this, and he would flourish without interfering to any appreciable extent with the balance of forces. Wild grains, fruits and vegetables grow in profusion, wild animals and birds are unsuspicious and readily taken. The simple wants of the primitive individual man are readily supplied, and his desires go no farther. The story of Adam and Eve in the Garden of Eden typifies this condition of man.

If in the early days, through some apparent miscarriage of nature's laws, the fine adjustment of some of nature's forces was, for a time, disturbed, man, like the lower animals, adapted himself to the changed conditions. If locusts overran the country, devouring man's vegetable food, he followed the example of the lower animals, and fed for the time on locusts. No doubt the food of John the Baptist in the

* Illustrated by stereopticon.

wilderness — "locusts and wild honey" — was very acceptable to him. If mice or rats abounded and destroyed a part of man's vegetable sustenance, he took it second-hand by feeding on rats and mice, as all other rapacious animals do if occasion requires. The individual was seeking only his own subsistence and that of his family. There was no agriculture, no money and no trade. But in an evil day man "ate of the tree of knowledge." To provide against possible want, he undertook to protect and propagate useful plants, with a view to increase his store of non-perishable food products. He also undertook to domesticate animals. This was the beginning of agriculture and civilization. Immediately birds, mammals, insects and plants became his enemies, and he has had to earn his bread by the sweat of his brow ever since.

With a new source of food supply and attention given to the arts of peace the population of the earth began to increase, man grew in intelligence, civilization succeeded to savagery, and man, by reason of his arts, became the principal factor among other animals, — bending all others to his will. By his artificial protection and propagation of species, he committed serious infractions of nature's laws. In thus disturbing the balance of nature, he brought upon himself the consequences. But in the course of centuries there came a gradual adjustment to the conditions of agriculture, so that in the older civilized countries to-day man and nature are more in harmony than in lands recently brought under the plow.

Now let us turn to the western hemisphere, where agriculture and civilization together have come hand in hand in comparatively recent times, and see some of the results of the settlement of the civilized agriculturist in the primeval wilderness.

When the Pilgrim Fathers landed at Plymouth, in 1620, they found there a wild country, sparsely inhabited by savages. Nature had been practically undisturbed by aboriginal man, and agriculture was in its most primitive condition. In the course of settlement the white man at once began to "improve" the wilderness, outraging nature's laws in many ways, and setting up serious disturbances among the

nicely balanced and finely adjusted series of organisms by which he found himself surrounded. He cut away the forest, which had clothed much of the country for ages. He introduced new plants and new animals. Trees, shrubs and vines, which had surrounded the country homes of the settlers in England or in other lands, were brought here and planted upon the virgin soil of the new country. Insect pests and noxious weeds were undoubtedly, though unintentionally, brought with them in some cases. The introduction of new plants and animals, something which nature without man's aid would not have accomplished perhaps in thousands of years, was undertaken and completed by man in a month, to be followed later by serious results, as in the recent cases of the introduction of the English sparrow, the gypsy moth and the Russian thistle.

The settlers, while subduing the aborigines and pushing them westward, began to make war on the lower animals. The bears, wolves and panthers, which attacked the flocks and herds, were the first to go. The deer and wild turkey, which attacked the growing crops and were good for food, soon followed. Then, under one pretext or another, the destruction of other native mammals and birds was begun, and is still continued throughout the country even to this day. As the march of civilization continued westward, large areas were devoted to special crops. These broad fields of Indian corn, wheat and other grains, of potatoes, peas and other vegetables, with great vineyards and orchards, offered an almost unlimited opportunity for the insect enemies of such plants to multiply. Thus the people, while destroying many of the enemies of the native insects, kindly provided those insects with an abundance of succulent food, giving them the very conditions needed to insure that tremendous increase in numbers of which they are capable. Under such conditions, insects like the chinch bug and the Colorado potato beetle were fostered and overran the land. In the primitive condition of the country these insects were undoubtedly harmless. This policy has been continued, until the United States has become noted as the greatest sufferer from insect pests of any country on the face of the earth. When, under bounty laws, the early colonists in New Eng-

land shot and trapped the crows and blackbirds because they ate corn, an increase of white grubs and cut worms followed soon after, which entirely destroyed the grass crop, so that the farmers were obliged to import hay from England for their cattle.* Nevertheless, the settlers continued the wholesale destruction of other birds. The wild turkey, prairie chicken and wild pigeon were very nearly exterminated. These and other grasshopper-eating birds being greatly reduced in numbers, plagues of grasshoppers or locusts appeared.† We are told that these insects so increased that the preachers felt obliged at their services in the churches to pray for deliverance. The local killing of blackbirds in the interior States has been followed by a great local increase of white grubs. One farmer from Wisconsin told me that he lost four hundred dollars' worth of grass in one year from the depredations of these insects. During the great locust invasions in the western States many farmers lost their all. But the people at last realized the value of the birds, and passed protective laws, which resulted in an increase of birds in those States. One farmer writes: —

> In answer to your question about the birds and the locusts, I must say this: every farmer that shoots birds must be a fool. I had wheat this last spring on new breaking. The grasshoppers came out apparently as thick as the wheat itself, and indeed much thicker. I gave up that field for lost. Just then great numbers of plover came, and flocks of blackbirds and some quail, and commenced feeding on this field. They cleaned out the locusts so well that I had at least three-fourths of a crop, and I know that without the birds I would not have had any. I know other farmers whose wheat was saved in the same way.‡

So in time the value of birds began to be recognized among the native population; but many of the later immigrant farmers, lacking such experience, continued the slaughter of beneficial birds, and even some native American farmers have yet to learn that most of the birds which live about them are beneficial. Many still shoot the birds that

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* See Kalm's "Travels in America."

† Williamson's "History of Maine," pages 102, 103, 172.

‡ First annual report of the United States Entomological Commission, 1877, page 342. Letter from S. E. Goodmore, Fremont, Neb.

eat their fruit or those that visit their corn fields. How many of us are aware that even the water birds are beneficial to agriculture?

Usefulness of the Water and Shore Birds.

Gulls, terns and many so-called shore birds often feed largely on insects. In England, where sea gulls are now protected, they will follow the plow in their search for grubs and other injurious insects. In this country they are so persecuted that they usually keep well away from inhabited shores, hardly daring to trust themselves near the habitations of man except about our city harbors, where shooting is prohibited. As an illustration of the usefulness of gulls during insect invasions, let me cite the oft-related experience of the early Mormons at Salt Lake. It is said that soon after they emigrated to Utah the black cricket (*Anabrus simplex*) appeared upon their crops in immense swarms, destroying the entire crop of wheat and other grains, and reducing many of the settlers nearly to the point of starvation. The next year these pests appeared again. Says Hon. Geo. Q. Cannon, "Promising fields of wheat in the morning were by evening as smooth as a man's hand, devoured by the crickets." At this juncture sea gulls came by thousands, miraculously, or providentially, as the Mormons believed. Their flocks whitened the blackened fields, and they destroyed the crickets so utterly that they were almost eradicated, thus saving the remainder of the crop, which was all the half-starved Mormons had to rely upon for food for the next season. The thankful people passed a law forbidding any one to kill these birds, and fixing a penalty for the offence. This occurrence was witnessed by many people, and a number of accounts of it have been published.*

Dr. A. K. Fisher of the Department of Agriculture says the gull referred to is Franklin's gull (*Larus Franklini*), which occurs in enormous flocks in the north-west, and feeds in such companies on grasshoppers, crickets and similar insects.†

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* Report of the United States Commissioner of Agriculture, Townend Glover, Entomologist, 1871, page 79. Second report United States Entomological Commission, 1878-79, page 166. "Agriculture of Massachusetts," 1871, page 26.

† "Insect Life," Vol. 7, No. 3, page 275.

The United States Entomological Commission, when investigating the locust outbreaks in the west with a view to finding some means of controlling them, reported that locusts had been found in numbers in the stomachs of most of the water birds.

These birds are not only of practical use to farmers, but they are also valuable to mariner and fisherman. In foggy summer weather the longshore fisherman is often able to guide his course for the harbor by observing the direction in which the sea birds fly with food for their young. The fishermen are often made aware of the presence of schools of fish by the gulls or terns hovering over the sea, and watching for an opportunity to pick up the small fish on which the larger ones feed. The navigator is also frequently warned of the rocks in such weather by the cries of the birds breeding upon them.

The sea birds have been so persecuted along the Atlantic coast that they have deserted many of the islands where they formerly bred, and it is only within a few years that any attempt whatever has been made to protect them. Protective measures have now been inaugurated, largely through the action of members of the bird protection committee of the American Ornithologists' Union. The union has begun steps to protect the sea birds in their breeding places. The work on the Atlantic coast was first commenced in Massachusetts by Mr. Geo. H. Mackay of Boston, a member of the committee from Massachusetts. Through his labors the terns and gulls on Muskegat and some other islands have received a measure of protection, which has resulted in a large increase of their numbers within two years. Mr. Wm. Dutcher of New York, another member of our committee, has in charge a fund which this year has been applied to the protection of birds breeding on various islands and shores from Maine to Virginia.* At the recent meeting of the union in Cambridge he made a very full and interesting report, which indicated that in most cases the numbers of the birds were largely increasing on the protected breeding grounds. If this work can be continued, a greater

* Great credit is due and should be given Mr. Abbott H. Thayer, a member of the union, who secured the contributions to this fund.

measure of protection given, and the promiscuous shooting of the sea birds for millinery purposes stopped, these beautiful and useful birds, which have few enemies beside man,—and woman,—will again occupy their breeding places along our coasts.

Birds and Soil Fertilization.

Aside from their usefulness as insect eaters, the sea birds have benefited modern agriculture in another way. In the Garden of Eden fertilizers were not necessary. The natural decay of organic matter, resulting from the death of plants and animals, maintained the fertility of the soil. When population increased so that fertile land was not plenty, man learned by experience how to treat the soil to make it productive, and began to apply different materials as fertilizers. It is said that the Pilgrim Fathers in 1620 found that the Massachusetts Indians, when planting corn, placed a dead fish (herring or shad) in each hill. The Peruvian Indians were known to have recognized the importance of guano as a fertilizer more than three centuries ago. It is said to have been held in such high esteem in the time of the Incas that the deposits on the Chincha Islands were jealously guarded, and the birds which resorted there were carefully protected, the death penalty being inflicted on any one killing birds there during the breeding season. In 1804, Humboldt, returning from his travels in America, carried to Europe some samples of this guano, and called attention to the value of these deposits. His announcement received little notice at the time; but within fifty years guano had revolutionized methods in progressive agriculture, and the possession of certain islands occupied by sea birds and the revenue therefrom had become a bone of contention between nations. These guano deposits are found on the breeding places of sea birds. The material consists mainly of excrement, combined with the rejected portions of the food. These birds, penguins, albatrosses, pelicans, gulls, terns, petrels and others, feed largely upon fish; therefore the manurial matter deposited by them contains quantities of nitrogen, phosphate and phosphoric acid.

The introduction of guano into civilized countries gave a great impulse to intensive cultivation. Some idea of the

A BREEDING PLACE OF SEA BIRDS.—Albatrosses (*Diomeda immutabilis*) on Laysan Island, H. I.
[Photograph by J. J. WILLIAMS, Honolulu.]

apparently inexhaustible amount of this material found on the Chincha Islands may be gained from the fact that the deposits covered the three islands in some places to a depth of ninety to one hundred feet. The demand for this material grew to such an extent that by 1850 the price in the United States had advanced to fifty dollars per ton, and it is stated that five million tons have been imported into England alone. In 1853 the Peruvian government, which controlled the islands, surveyed them, and reported that there were still more than twelve million tons available. So great has been the demand, however, that this enormous quantity has now been practically exhausted. The call for the new fertilizer became so great and its price so exorbitant that American enterprise (under the encouragement of an act of Congress) began to explore the Pacific and the Carribbean Sea in a search for unclaimed islands. Claims under this act have now been filed with the United States government to about seventy-five islands, and many others have been discovered by the citizens of other nations in different parts of the world.* Of late years, however, the demand for concentrated fertilizers has resulted in their manufacture, so that they have largely taken the place of guano in intensive cultivation. But this subject presents itself in another aspect.

All along the Atlantic coast, from Maine to Florida, there are rocky or sandy islands which were once the breeding places of innumerable sea fowl. There are also many swamps and marshes where countless ducks, herons and other water and wading birds once bred. These birds were constantly gathering a harvest from sea, lake and river, in the shape of fish and other marine or fresh-water animals. The digestion of these birds is remarkably rapid. They require an enormous quantity of food. Therefore, they must have contributed considerably toward the building and enrichment of the soil of our originally barren coasts and islands. If they increase under protection and reoccupy their former breeding grounds, a double benefit to agriculture will ensue.

Aside from soil fertilization, the relation of birds and other animals to agriculture depends mainly upon the char-

* "A Review of Economic Ornithology in the United States," by Dr. S. T. Palmer, Year Book, Department of Agriculture for 1899, pages 278, 279.

acter and quantity of their food. By obtaining a knowledge of the various components of the food and their comparative amounts, we may form some judgment as to the comparative value of beneficial birds to the farmer. Birds are useful or injurious to agriculture according to the extent to which they feed on the crops of the farmer, on animals useful to him, or upon those which are injurious to his interests. There are birds which live almost entirely on injurious insects, and do not attack any crop. Such birds are certainly among the farmer's best friends. There are others which live largely on injurious insects and weed seeds, and do not materially injure any crop. Such birds are also eminently useful to agriculture. There are omnivorous birds which are often among the farmer's best friends, — destroying many of his worst enemies, — yet they are at times very injurious, attacking crops or poultry and destroying other beneficial birds. Whether the omnivorous birds are beneficial or not depends largely upon conditions and circumstances. To this class crows and magpies belong.

There is another class of birds which feeds almost entirely upon animals. These, the Raptores, or birds of prey, always have been classed by the majority of people among the arch enemies of the farmer. Science and expert experience do not, however, agree altogether with popular opinion on this question.

Hawks and Owls.

Admitting that the eagles are injurious, let us consider briefly the hawks and owls (*Falconidæ* and *Strigidæ*) in their relation to agriculture. It is only within recent years that any information has been generally disseminated here in regard to the usefulness of these birds. In England and Scotland, however, the value of certain hawks and owls has been known for centuries. We find that in Stowe's "Chronicle" in 1581 it is quaintly stated that "About Hallowtide last past (1580) in the marshes of Danessy Hundred in a place called South Minster in the County of Essex there sodainlie appeared an infinite number of field mice which overwhelming the whole earth in said marshes did sheare and gnaw the grass by the rootes spoiling and tainting the same with their venimous teeth in such sort, that the cattell which grazed thereon were smitten with a

Screech Owl.

COMMON USEFUL OWLS (*Megascops asio*).
[From Warren, after Audubon.]

murraine and died thereof; which vermine by policie of man could not be destroyed till at the last it came to pass that there flocked together such a number of owles as all the shire was able to yield, whereby the marsh holders were shortly delivered of the vexation of said mice. The like of this was also in Kent."

While we may be permitted to doubt the accuracy of the deductions which attributed the cause of the murraine, history has often repeated itself in regard to these outbreaks and their suppression. Similar sore plagues of mice were experienced again in Essex in 1648, in Norfolk in 1745, and they occurred regularly at this time about once in seven years at Helgay near Downham market, but a prodigious flight of "Norway owls" always appeared and destroyed them. Such outbreaks as these have occurred in different parts of the British Isles for centuries, but they have always been checked by the appearance of hawks and owls, until in 1892 in the south of Scotland. Then, their natural enemies having become somewhat reduced, they appeared in vast herds over an area of eighty thousand to ninety thousand acres. A preponderance of opinion among the farmers was reported, tracing the cause of this outbreak to a scarcity of owls, hawks and weasels and other so-called vermin. There have been somewhat similar experiences in the United States. In recent years the shooting, trapping and poisoning of carnivorous animals and rapacious birds in the west has been followed by a tremendous increase in numbers of the prairie hare or "Jack rabbit." These rabbits have become such a nuisance that whole communities have to turn out and drive them into prepared enclosures, where they are clubbed to death.

Some of you may recall how Dr. B. H. Warren, State ornithologist of Pennsylvania, standing on this platform, once told you of the experience of the people of that State with bounty laws, framed to secure the destruction of crows, hawks, owls, foxes, etc. You will not remember, perhaps, that the different counties of the Commonwealth of Pennsylvania paid out of their respective treasuries in one year nearly eighty thousand dollars in bounties on the heads of hawks and owls killed in that State under the so-called scalp act of 1885; that finally the stomach contents of three hun-

dred and fifty of the birds on which bounties had been paid were examined by Dr. Warren and by Dr. C. Hart Merriam, government ornithologist at Washington, or his assistants, and that it was found that ninety-five per cent of the food of these hawks and owls consisted not of poultry or game, but of field mice and other destructive mammals or grasshoppers and other destructive insects. The scalp act was repealed at the next session of the Legislature.

Ever since the settlement of this country hawks and owls have been proscribed by both farmer and law maker, and shot at sight by nearly every one who owned a gun. They have been classed as the thieves, thugs and assassins among birds; but many of them are now known to be useful in the highest degree to agriculture, while only a few can possibly be classed as injurious in the main. There are a few hawks which are inveterate enemies of poultry. The goshawk, Cooper's hawk and the sharp-shinned hawk are very destructive to poultry, birds and game. The first occasionally winters with us, and in that season of scarcity secures more or less poultry and much game. The other two are noted for their depredations mainly in the spring, when their growing young in the nests require a great amount of animal food for their sustenance. The red-tailed hawk occasionally takes poultry at this season, and now and then a marsh hawk becomes addicted to chicken stealing; but as a rule they and all the other hawks common in Massachusetts, with the exception of the first three mentioned, are now believed to be beneficial to agriculture, some of them highly so. Of the owls, there is but one — the great horned owl — which feeds to any great extent on poultry. This species is so hunted that it is fast becoming rare in this State. If fowls are shut up at night, this bird will seldom secure any. The hawks and owls not only benefit the farmer by constituting a check on the too great increase of mice, rats, squirrels, hares, moles and other destructive rodents, but they also assist greatly in checking insect outbreaks, as they feed on such injurious insects as May beetles, the larger caterpillars, grasshoppers and locusts.

The volume entitled "The Hawks and Owls of the United States," by Dr. A. K. Fisher, one of the ornithologists of

the United States Department of Agriculture at Washington, D. C., should be in the hands of every farmer. It contains excellent colored plates of the more common species, with much on their habits and food. Having made an exhaustive study of the subject, having corresponded with many field ornithologists and examined the contents of the stomachs of some two thousand hawks and owls, Dr. Fisher says, "It may be stated with confidence that owls are the most beneficial of all birds." This bulletin has long been out of print. This Commonwealth could perform no greater service to the farmers than to publish a reprint and distribute it freely among the agricultural community. "Unless the farmer has some means of identifying these birds, how is he to distinguish the good from the bad?" When once fully identified, they may be distinguished as readily as the different animals on the farm. They are large birds, and their differences are fully as well marked as those of the standard breeds of poultry. The farmer or poultry-man who will make it a rule to shoot or trap only those of the hawks and owls that actually take poultry, will, by his forbearance, benefit mankind. We might go still farther, and say that some even of those that occasionally steal a chicken should be spared for the good they do in the pasture, orchard, meadow and woodland.

Cuckoos (*Family Cuculidæ*).

The cuckoos are about the only birds that were generally known to feed extensively upon hairy and spiny caterpillars, until an investigation in Massachusetts gave evidence that many other birds were killing these insects. This habit of the cuckoos is so conspicuous that it has been observed by nearly all writers who have studied either cuckoos or caterpillars. The caterpillar habit of the cuckoos became so well known in the work on the gypsy moth that a gathering of cuckoos anywhere was looked upon as a sign of a caterpillar outbreak. It is a well-known fact that these birds eat so many caterpillars that their stomachs sometimes become lined or felted with the hairs from the bodies of the insects. Some of the most destructive insect pests suffer from the attacks of these birds. The tent caterpillar, forest caterpillar, gypsy moth, brown-tail moth, black-spined caterpillar,

fall web worm and the canker worms are all greedily eaten. Mr. F. H. Mosher saw a yellow-billed cuckoo go to a nest of fall web worms, tear it open and take twenty-two of them in a few minutes. Many such occurrences as this are now on record. The cuckoo should be welcome everywhere.

WOODPECKERS (*Picidæ*).

Thanks to the writings of foresters, ornithologists and entomologists, the woodpeckers, which were long considered fair game for the gunner, are now recognized almost everywhere as useful birds. Our largest common species, the flicker, is so fond of ants that it will alight on an ant hill, thrust in its bill to bring out the inmates, and then gorge itself on the agitated ants as they swarm from the opening. Ants form a large portion of the food of many wookpeckers. The sapsucker was considered an injurious bird for many years, but Frank Bolles showed that its tapping trees ordinarily produced no serious injury. Some farmers will persist in applying the term sapsuckers to the black-and-white woodpeckers. Ornithologists have always claimed that these birds are not sapsuckers, but now it seems that possibly the farmers have not been so much in error after all. In regard to this, I beg leave to submit the following field notes, from my friend Mr. C. E. Bailey of Winchendon, dated Malden, Mass., April 6, 1899: "At 12.30 I found a downy woodpecker, and watched him till 2.45; he took three larvæ from a maple stub, just under the bark. He next tapped two small swamp maples, four and six feet from the ground, and spent most of the time taking sap. He tapped the tree by picking it a few times very lightly; it looked like a slight cut, slanting a little. The bird would sit and peck the sap out of the lower part of the cut. The cut was so small the sap did not collect very fast. The bird would go and sit for a long time in a large tree and not move, then it would come back and take more sap. It did this three times while I was watching it. It did not care to take any food but the sap. I could get within six feet of the bird without any trouble when it was taking sap. It then left and went into a large tree, and I lost it; but if I had stayed by the tree it tapped I think it would have come back

before night, as it had done before when I was watching it. It was gone half an hour at one time."

While this cannot be considered as proof that the downy woodpecker is a sapsucker, still, it shows that one bird certainly did take sap, though not from a fruit tree or in any harmful quantity. Therefore, it seems probable that an occasional individual of the same or allied species may have the same habit, and that the only reason it has not been observed before is that the birds have not been watched with sufficient care. For the good they do, woodpeckers are deserving all that they can ask at the hands of the farmers. One useful trait of the downy woodpecker not generally known is its feeding upon the woolly aphis, which is so often seen on our apple trees. This has been observed by Mr. A. H. Kirkland. Woodpeckers not only secure many wood-boring insects which are injurious to trees, but they destroy many eggs and hibernating pupæ during the winter months.

The Goatsuckers (*Caprimilgidæ*).

These, represented in Massachusetts by the night hawk and whippoorwill, are without doubt of great utility. Both these species destroy such night-flying insects as the May beetle, which is the parent of the white grub. They also eat night-flying moths, so many of which escape diurnal birds. Dr. B. H. Warren reports the whippoorwill as feeding on potato beetles.* Dr. L. O. Howard says that night-flying birds, such as night hawks and whippoorwills, destroy the adult mosquitoes.† Mrs. Aaron, in the "American Naturalist," says that Harvey found six hundred mosquitoes in the stomach of a single night hawk.‡ Unfortunately, these birds have been so hunted that there are now few where once there were many.

Swifts (*Micropodidæ*).

The swifts, of which our chimney swallow, so called, is the sole example inhabiting this State, are believed to feed

* "Birds of Pennsylvania," revised edition, 1890, page 180.

† Dr. L. O. Howard: "The Mosquitoes of the United States," Bulletin 25, new series, United States Department of Agriculture, Division of Entomology.

‡ "American Naturalist," 1880, page 896.

entirely on insects, which they take on the wing. They pick up in this way such caterpillars as the canker worms, which often hang suspended by a thread they have spun from the branches. We have very little accurate information as to the exact character of the food of these birds.

Humming Birds (*Trochilidæ*).

Even the little humming birds eat many minute but nevertheless destructive insects, which they take not only from the leaves and flowers but even from the branches. The ruby throat may sometimes be seen hovering beneath or about a limb, pecking insects from the bark.

Flycatchers (*Tyrannidæ*).

The true flycatchers take their food largely upon the wing. Although they eat caterpillars and other larvæ and also some pupæ, they feed in the main upon the mature insects taken in flight. They are no doubt beneficial to agriculture, but perhaps not so highly useful as it would seem at first sight, as they destroy many parasitic insects after these creatures have reached the winged state. The kingbird, which has received in some sections the name of bee eater or bee martin, probably does more good in destroying robber flies, bee moths and other insects than it does harm by killing bees. The stomach dissections made by Professor Beal of the Department of Agriculture resulted in favor of this bird. Kingbirds nesting near the poultry yard will keep hawks and crows away.

The Crow Family (*Corvides*).

This Board has already published a report on the crow in Massachusetts. Since that time more facts in the crow's history have come to light. It seems to be true that in the Middlesex Fells reservation, where all birds have been protected, the crows have increased at the expense of the smaller birds, which certainly appear to be less plentiful there than they were before the Metropolitan Park Commission took the land. On the other hand, the grouse and hares have greatly increased. Our observers have reported that many nests of robins, vireos and other small birds in the reserva-

tion were being robbed by crows and jays. Hence we may conclude that if crows are allowed to increase too rapidly they may do much harm. Still, those who regard the crow as an evil must certainly admit that it is a necessary evil, where grubs, caterpillars or grasshoppers become numerous.

The blue jay is a sad rascal, no doubt. It has a great appetite for grain and fruit, and destroys some birds' eggs. On the other hand, it is a noted caterpillar hunter, and is one of the few birds that eat the eggs of the tent caterpillar and other harmful insects in winter. As this bird remains in Massachusetts most of the winter, it must do a vast amount of good unnoticed during the colder months of the year, when it can do little harm.

The Starlings and Blackbirds.

The members of this family are, as a rule, highly beneficial to agriculture. The bobolink and some of the blackbirds are rightly considered great pests in the southern rice fields; the redwings and crow blackbirds, when too numerous at any point for their normal food supply, do much injury in grain fields, especially among Indian corn. But the amount of grain eaten by each bird for the season is of little consequence, compared with the enormous number of insects it destroys. The difficulty is in this case that the good the birds do is distributed unnoticed over a wide region and through many months of each year; while the harm done is confined to a few months and to more limited areas, and so attracts much more attention. The injury is largely done in the fall, when, the breeding season being over, the birds collect in immense flocks. Where these flocks descend upon the grain fields, the farmers whose crops so suffer receive little consolation from the fact that the birds that have destroyed their grain have but recently been rendering priceless service to their neighbors or to other farmers over a wide stretch of territory. It seems hard for the southern rice planter to be obliged to pay the bobolinks and blackbirds from his fields the price they exact for protecting from the ravages of insect pests the grain fields, grass crops and gardens of the north. Here the bobolink is one of the most useful birds. It remains here during the breeding

season only, when it feeds largely on insects, helping to hold in check some of our most important pests. During army worm invasions the bobolink has become known as the army worm bird, because of its persistent attacks upon the worms. Ants, wasps, grasshoppers, harmful beetles (including weevils), caterpillars, plant lice and many other injurious insects are eaten in numbers; also grass and weed seeds. Prof. F. C. Beal says that this bird destroys many parasitic hymenoptera. These are useful insects, and this seems to be the only harm done by this bird in the north. During the past twenty years the bobolink has greatly decreased in many parts of Massachusetts. The early mowing, by machines, of the fields in which it breeds, may be partly responsible for this, for in this way many nests are either destroyed or exposed to destruction by the bird's enemies.

The cowbirds, as you all know, follow the cattle about the fields and pastures, feeding largely on the insects which always fly from the towering presence of large animals. They seem to court the vicinity of the cattle for this reason, as chickens often do and as swallows sometimes do for much the same purpose. Such being their habit, their food is such as might be expected, and they feed largely on grasshoppers and other grass-inhabiting insects and cutworms. Their young are sometimes raised at the expense of the lives of other birds, although occasionally they are brought up in the nest with the children of their foster parents. One often sees young cowbirds tended and fed by other birds much smaller than themselves. It is quite probable that the cowbird is as useful to the farmer as the majority of the birds it displaces.

The redwing and crow blackbirds are noted for their fondness for white grubs, cut worms and other caterpillars. Wilson says he believes that fifty of these larvæ per day would be a very moderate allowance for a redwing. He estimates that a million pairs of these birds and their young occupying this country in summer consume sixteen thousand two hundred millions of such insects in four months. The crow blackbirds certainly destroy some of the eggs and young of other birds, but it is doubtful if this is a constant habit of the species. Although individuals manifest it, stomach examinations show little of it. All farmers know

that certain hens habitually break and eat eggs. Undoubtedly individuals among birds have a similar habit, and it will crop out sometimes where least expected. It cannot be doubted that catbirds, wrens and cuckoos occasionally have this habit, as do jays and crows. Even the Baltimore oriole — a member of the family we are now considering — has now and then been seen to attempt to destroy the eggs of other birds. That it sometimes succeeds is shown by the following note from Mr. Mosher: "Monday, June 12, 1899: While making observations on a pair of rose-breasted grosbeaks, my attention was called to the cries of two male orioles. They were having a pitched battle every few minutes. On going to the spot, I found that one of the males was fighting the other away from the nest, which was in the top of a small birch. The bird that owned the nest would perch just above the nest and keep guard. In a few minutes the other would make a rush at the nest from a neighboring tree, and they would grapple and sometimes come nearly to the ground. They kept this up *all of the three hours I was near them*. The bird without a mate went to a redstart's nest that had two eggs in it, and, taking the eggs in his bill, threw them out of the nest to the ground. He then attacked the nest, using his beak and feet, and exerting his strength to the utmost, until he had tipped the nest out of the crotch and it fell to the ground. Then he went back to the trees near the other orioles. Tuesday, June 13, 1899: An oriole, probably the same observed yesterday, went to a red-eyed vireo's nest and threw out one of the eggs, and would probably have thrown out the others if the vireos had not attacked him and driven him off."

With the oriole this habit so far as observed has been confined to male birds which were probably unmated. It may be a mere eccentricity. The oriole is certainly one of our most useful birds. It is a great destroyer of the canker worm and tent caterpillar. It is, in fact, an inveterate feeder upon caterpillars and other orchard pests. It also eats great numbers of grasshoppers, injurious bugs and beetles. Wire worms are also eaten by it. The farmer should not only welcome the oriole, but furnish it with nesting material and fruit if necessary.

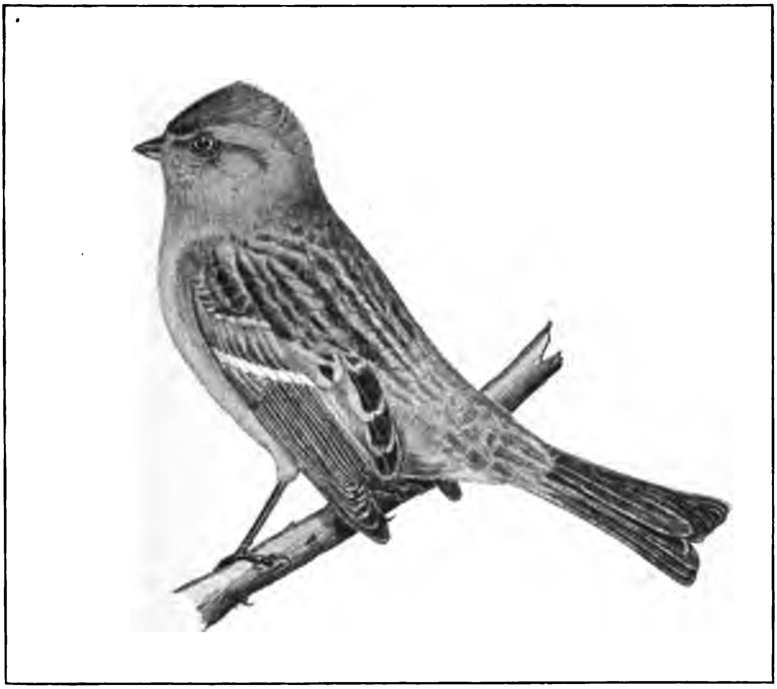
The meadow lark is one of the most useful birds of the fields. Grasshoppers and other grass-eating insects, May beetles, caterpillars and other leaf-eating insects constitute a large part of its bill of fare, and it is not known here at least to have any really harmful habits. This is another bird which has been greatly reduced in numbers in this State, partly by gunners and partly, perhaps (as in the case of the bobolink), by early mowing in the fields and meadows.

Sparrows (*Fringillidæ*).

And what shall we say of the great sparrow family, well represented here by numerous species? These birds, though nominally seed eaters, are second only to some of our most truly insectivorous birds in their value to man. Not only do they and their young destroy vast numbers of insects in the spring and summer, but they also eat innumerable weed seeds in the other months they remain with us. Very few of them can be said to be harmful in any respect. The rose-breasted grosbeak is one of the few birds that eat the Colorado potato beetle. Among the most useful sparrows are the chipping sparrow, so common about the farm-yard, and the indigo bird, the male of which is so conspicuous for his bright blue plumage. These birds eat many of the worst pests of the garden. The indigo bird is particularly useful in the corn-field. The junco and tree sparrow are useful winter species.

Tanagers (*Tanagridæ*).

The scarlet tanager, which is the only member of the family at all common here, is largely a bird of the woods, though frequently seen in the orchard. It is pre-eminently a tree bird, and feeds upon many insects, which in their turn feed on the leaves or twigs of trees and shrubbery. Its characteristic song and beautiful plumage of black and scarlet make it a general favorite. It is especially the guardian and protector of the oaks, living mainly among them and feeding on their insect enemies. Large moths, like the Luna and polyphemus, are captured by the tanager, which shears off their wings and legs with its beak and then devours them. This bird also catches and beats to death the hairy caterpillars, and either swallows them entire or tears them to



THE TREE SPARROW (*Spizella monticolor*).
[A useful winter bird feeding largely on weed seeds.]

pieces. Leaf galls are pecked open by it and the grubs extracted from them. I have elsewhere recorded the fact that a male tanager was seen to eat over thirty newly hatched small gypsy moth caterpillars within five minutes, when he was joined by a female, and both together continued eating at this rate for eighteen minutes. Most of the numerous host of oak tree insects must reckon with the tanager as a vigilant and remorseless pursuer. This bird is also exceedingly useful in the garden or orchards, near its favorite white oak groves.

SWALLOWS (*Hirundinidæ*).

It is unfortunate that the swallows are not so numerous now in this State as they were thirty years ago. Many barn lofts where the barn swallows once bred no longer resound to their twittering. Many colonies of eave swallows have been broken up. The white-bellied or house swallows and the purple martins have been driven away from their nesting places largely by the imported English sparrow. The bank swallow has almost disappeared from some sections of the State. I know of no present breeding place of these birds in Essex County. As all the swallows feed almost entirely upon insects, when they can secure them, they will, when abundant, do much to clear the air of flies, gnats, mosquitoes and other winged hosts. They are said to destroy many of the flies which trouble cattle, and they also feed upon caterpillars like the canker worms, and many destructive beetles like the so-called "rose bug."

Their food habits in this State have never been closely studied. Their decrease of late years is partially owing to unusual cold and storms in the south, which have destroyed many during their southern migrations. It is partially due also to their persecution by man, and in the case of the bank swallow it may be due in some measure to a contagious disease.

WAXWING (*Ampelinæ*).

The cedar bird or cherry bird is surely a useful bird, and it would pay the farmer to plant cherry trees, if only for the purpose of attracting these birds to the orchard and garden. Although they feed to a great extent on cherries and wild berries in summer, and in winter on the fruit of the red

cedar, yet they are voracious feeders on such pests as the canker worm. In this respect few birds can be more useful. They have been thoughtlessly decimated by the shot gun in many localities in this State. Although they possess no power of song, they are among our most beautiful and delicate birds.

Vireos (*Vireonidæ*).

This family of birds, famous for their vocal powers, should also receive recognition from the farmer as caterpillar hunters. At this occupation they almost equal the cuckoos. The red-eye seems to stop singing only to hunt for or eat a caterpillar. Their graceful movements, their powers of song and their elegant pensile nests should make them welcome everywhere.

Warblers (*Mniotiltidæ*).

Of the great family of wood warblers we know only that which is good. They migrate through this State in spring and fall, leaving many of their number to summer here; but all or nearly all leave for the south in the fall, to appear again only when the spring sun mounts high in its daily course and the numerous hibernating insects awake to a new year. These warblers' graceful forms, bright colors and feeble lisping songs have made them favorites among ornithologists. Their valuable services in destroying insects should insure the favor of all. Every spring and fall their hordes pass through this Commonwealth unnoticed by most people. There are few of the insects of the orchard, fruit garden or wood lot on which these birds do not feed, and the number of insects destroyed by them must be entirely beyond man's comprehension.

Wrens and Thrashers (*Troglodytidæ*).

The house wren, though perhaps locally common, is now in most parts of the State a rare or uncommon bird. Undoubtedly the introduction of the English sparrow had much to do with its disappearance from Worcester County. It has been proved that it is possible in some cases to tempt the wrens back to their former homes by putting up nesting boxes with an auger hole seven-eighths of an inch in diameter as their only

entrance. Through this small hole the sparrow cannot enter, and, if the wren can only keep the sparrows out of its nest, it will give a good account of itself. This bird is an indefatigable worker in the garden, and delights in destroying cabbage worms, currant worms, onion flies and all such vermin. It eats also many spiders. The winter wren is not often seen except in the woods, and its food habits are not well known.

The brown thrasher, sometimes called the red mavis or planting bird, and the cat bird, are both familiar and useful. Their special province is to clear the shrubbery and low growth of caterpillars and other pests.

Titmice, Creepers, etc.

We cannot overlook in passing that interesting group of familiar winter birds that are seen in company during this inclement season busily searching over trunk, branch and twig, prying into every hole and crevice,—the creepers (*Certhiidæ*), titmice and nuthatches (*Paridæ*) and kinglets (*Regulinæ*).

Every village orchard, every isolated farm, every wood lot in the State, undergoes their searching scrutiny. They go in small companies, sometimes one or two species together, sometimes three. Often they are joined by one of the smaller woodpeckers. Almost exclusively insectivorous, they rely on other food only when driven by extremity. They must labor almost incessantly to secure sufficient food to keep up the vitality necessary to resist cold and storms. Still they always appear cheerful and contented. Searching the trees continually during daylight, they destroy vast quantities of the eggs of injurious lepidoptera and aphides. They drag from their hiding places thousands of hibernating insects. The bark beetles are haled forth, the tineids sought out, the scales destroyed. In the warmer days, when the pregnant female moths leave the ground and climb the trunks preparatory to depositing their eggs, they are gladly pounced upon and hailed by these little bird waifs, perhaps as a sign of coming spring. All through the winter, when other birds have fled to a warmer clime, these birds remain steadfastly with us, battling with the

elements and delivering our trees from a host of potential insects, which, otherwise, would develop and swarm upon them in the spring. Many of these birds are destroyed by cold and storms, but the survivors, undaunted, still linger, seeking protection from the fury of the elements wherever they can find it.

My friend Mr. C. E. Bailey once discovered two chickadees hiding during a snow storm in a cavity beneath a deserted crow's nest. It was snowing hard, and night was coming on. Mr. Bailey, seeing something moving among the twigs and leaves of which, the nest was composed, climbed the tree. The birds remained until his hand was quite near them, when they flew out, but they returned to their shelter before he had reached the ground. There they probably passed the night. On another occasion a storm of cold rain and sleet had covered the trees with ice. Mr. Bailey saw two poor chickadees, almost exhausted from exposure and lack of food and their tails covered with ice, crawling beneath the loosened clapboards on an old building for shelter from the storm.

The chickadee is, perhaps, the most useful bird of this group. It will well pay the farmer to provide food and shelter for these birds during the winter months and so keep them about the orchard and farm buildings. He can secure no better return for a small outlay.

The clock warns me that there will be no time to more than mention the useful thrush family. But it is always expected that something will be said about the robin. My own opinion of the robin may be judged by my treatment of the bird. There is a white pine grove within a few rods of my home, where the robins resort to roost in August and September. They come after sunset by hundreds, roost in the pines all night and scatter round about to feed at early dawn. Among them is one albino bird, white with a black head. If those robins continue to come there that white pine grove shall continue to furnish them a place of refuge. I have ordered two dozen cherry trees to be planted in the vicinity, as a further attraction to the birds. They are the most expert bird at digging out and killing white grubs, —

THE WHITE BREASTED NUT HATCH (*Sitta Carolinensis*).
[A destroyer of tree pests.]

except, perhaps, the crow. The cut worms have no worse enemy.

It may be inferred from all of the foregoing that most birds are believed to be useful to agriculture.

Food Relations of Birds and Other Animals.

And now a word about the food relations of birds. It is a general rule that any animal or plant which, through circumstances particularly favorable to its multiplication, becomes abnormally numerous, will at once, in the struggle for existence, become unduly destructive, and therefore a pest. When crows, blackbirds, rabbits or any bird, mammal or insect become too numerous, or when too many of any one species are crowded too closely on a limited area, then only do they become pests. What animal so harmless as a rabbit? Yet in Australia great tracts of land have been made barren by the multiplication of these little animals. Man himself tried in vain for years to check them.

It is often said that birds destroy both useful and beneficial insects or other animals, and that this fact detracts from their usefulness. But it must be remembered: (1) that the species of injurious insects out-number the so-called beneficial insects enormously, therefore the vast majority of insects destroyed by birds are the injurious ones, and that these fewer beneficial insects alone could never hold the many injurious insects in check; (2) certain beneficial insects themselves would become injurious if not for the check put upon them by birds which devour the surplus.

One never can tell what any creature will eat if pressed by hunger, or what change may occur in the food habits of any species when that species becomes abnormally numerous. Any arbitrary classification of animals by their food habits, as absolutely insectivorous, carnivorous, etc., will fail in view of this fact. The animals themselves are not aware of our distinctions, and refuse to be bound by them. In my earlier years I was surprised to find the wolf, a carnivorous animal, subsisting on berries, and swallows, insectivorous birds, also living on the same food. Later we found a climbing cut worm eating the pupæ of the tent caterpillar.

We now know that predaceous beetles, such as the *Harpalide*, when they become numerous sometimes attack grain or fruit. Granting, that a species may change its status from beneficial to injurious the moment it becomes too numerous, birds are certainly performing a great service, provided they keep insects or other animals within normal bounds.

But it may be said that there are some species, like the predaceous beetle of Europe, *Calosoma sycophanta*, and perhaps our own *Calosomas*, which feed entirely on other species of insects except when such food is scarce, and then they eat each other, and that such species, therefore, would never become pests. This is true, but the usefulness of these cannibalistic species is likely to be abridged by their own voracity, and only a few birds are known to eat them. We must admit, however, that, if these birds seriously reduce the numbers of such insects, then they do harm, which must be counterbalanced by their general usefulness in destroying other insects.

Birds are especially fitted by structure and habit to destroy insects. They will do it effectually wherever they are sufficiently numerous and are allowed to work unhindered. That they are not now sufficiently numerous in Massachusetts is largely the fault of the inhabitants.

Man the Destroyer.

Some of our useful birds have been almost exterminated from this State, within my memory. The passenger pigeon has gone within twenty-five years. A hundred years ago their flocks darkened the sun. Bartram's sandpiper, otherwise known as the upland plover, bred not uncommonly on the hills about Worcester thirty years ago. This is an exceedingly valuable bird in grass lands. It was wanted, however, by the epicures. The pot hunters got after it. Now you may occasionally hear one flying over in the spring or fall, but we do not know where they now breed in the State. The woodcock has bred commonly in eastern Massachusetts within thirty years. The young birds were raised in some numbers about Worcester twenty years ago. Breeding birds are now rare. The pot hunter has destroyed them. Most people are unaware that the northern quail is

now an exceedingly rare bird. This remarkably useful bird — one of the few that feed on the Colorado potato beetle — has been so nearly exterminated that the smaller, darker southern variety has been introduced by sportsmen to fill its place. These birds have probably interbred with the larger northern birds, and have practically wiped out the remnants of the race. Our sportsmen have at last awakened to the fact that even the wily grouse may go the way of the quail, plover and woodcock; and a law has been enacted making it a punishable offence to sell any of these birds shot in this State.

Many of the smaller birds, once very common here, are now comparatively scarce. A western naturalist, coming east, at once noticed the scarcity of birds, as contrasted with their abundance now in certain of the western States. It will not do to say that we can do nothing toward increasing their numbers. We certainly have done much to reduce them. We know that it is in man's power to make conditions which will favor their increase. Our bird laws are fairly good, but they are not enforced. Birds are slaughtered, by thousands, as they ever were, by boys, cats, immigrants, pot hunters and would-be sportsmen. Of those birds which escape the slaughter, only about one pair in five manage to rear their young to maturity. When this destruction of our birds can be checked, then, and then only, will the birds begin to reoccupy their rightful economic position in our midst.

It is gratifying to note that the United States government is now taking an active interest in bird protection. The passage of the "Lacey act" by Congress and the measures taken for its enforcement by Dr. T. S. Palmer, the capable and energetic assistant chief of the Biological Survey, give promise that the illegal slaughter and sale of birds for millinery purposes, as well as their illegal sale in the game markets, may in time be stopped. This is a work in which the authorities here should heartily co-operate.

EVENING SESSION.

The meeting was called together by President H. H. Goodell of the Massachusetts Agricultural College, who said: The subject of the lecture this evening is "Some Lessons from the Census." I think some of you may have said in your hearts that a skeleton made up of facts and figures would be dry. I am sure if any man could quicken into life that same skeleton of bones, it is the lecturer to-night.

Those of you who are old enough will doubtless remember that seven and thirty years ago the Legislature of this Commonwealth accepted a grant from Congress of three hundred and sixty thousand acres of public domain, with the proviso that the money derived from the sale of that land should establish and maintain at least one college of agriculture and mechanic arts. The Legislature immediately founded and established the Massachusetts Institute of Technology, giving them one-third of the income derived, and three days later, I think it was, they established the Massachusetts Agricultural College, in that way providing for the college of agriculture and mechanic arts. I have the great pleasure of introducing to you Dr. Henry S. Pritchett, the president of our twin institution, the Massachusetts Institute of Technology.

SOME LESSONS FROM THE CENSUS.

BY DR. HENRY S. PRITCHETT, BOSTON.

My object in speaking to you concerning the census is not so much to present the results of the twelfth census of the United States, which is now being prepared, but rather to call attention to the work of the census; to indicate the value of the data collected, particularly as it affects those engaged in agriculture; and, finally, to bring forward certain general considerations which the results of recent censuses have seemed to establish.

The idea of a census, so far as the enumeration of the population is concerned, comes down to us from antiquity. One of the first of which we have record is that taken by David and mentioned in the twenty-fourth chapter of Second Samuel. The census concerned itself with the enumeration of men capable of bearing arms, and was completed in about nine months, which may be considered rapid work for that day. It revealed a fighting strength in Judah and Israel of about 1,300,000 men,—an exhibit of military resources sufficient to cause the heart of any king to swell with pride. The result was most disastrous, and, as a punishment for the pride and presumption which were displayed, David, who had caused the enumeration to be made, was given a choice of three evils, as the following extract shows:—

So Gad came to David, and told him, and said unto him, Shall seven years of famine come unto thee in thy land? or wilt thou flee three months before thine enemies, while they pursue thee? or that there be three days' pestilence in thy land? now advise, and see what answer I shall return to him that sent me.

And David said unto Gad, I am in a great strait: let us fall now into the hand of the Lord; for his mercies are great: and let me not fall into the hand of man.

So the Lord sent a pestilence upon Israel from the morning even to the time appointed: and there died of the people from Dan even to Beersheba seventy thousand men.

Whether the unhappy coincidence of this census with the plague is responsible for the widespread aversion to the exact enumeration of inhabitants which existed both among Christians and among Mohammedans for many centuries I am not able to say, but such a feeling undoubtedly existed. As late as 1753, when a measure for the institution of a census was pending before the British parliament, a member who opposed it placed his opposition on the following ground: "The people looked upon the proposal as ominous, and feared lest some public misfortune or an epidemical distemper should follow the enumeration."

In the tabulated results to which I am going to invite your attention will be found many evidences of the astonishing growth and power of the American people. Happily the time has gone by when such evidences of greatness bring superstitious fears. Such tabulated results, if accurate, must serve not only to bring to our attention those things in which we excel, but also those things in which we are falling behind. They serve to remind us not only of our greatness, but of our weakness; not only of our relative growth, but of our true position with respect to competitors; and they are therefore valuable not only in upholding our spirit of pride and security, but in pointing out also those sources of weakness of which it is well to be reminded from time to time, "lest we forget."

The census, in the modern sense, as does the word itself, comes to us from the Romans. With them it was a political military and fiscal agency, and was taken every five years. The enumeration and consequent registration were accompanied by religious ceremonials and sacrifices for purification of the people,— an idea which is somewhat akin to that fear of an enumeration to which I have just alluded. The census was taken under the conduct of two officers whose powers were the highest in the State, who were called "censors." Ultimately the powers of the censors were so extended as to include the supervision and correction of morals, and even to

the purging of the Senate of unworthy members,— a public duty which in this day is not delegated to formal officers, but for whose absence from our political system there may be reason for regret.

With the dissolution of the Roman empire the census as a statistical agency disappeared from history, and accurate enumeration of population, property and productions were only undertaken among modern nations within comparatively recent times.

By the constitution of 1787, a census, to be taken every ten years, became a part of the political system of the United States. It was a necessity of the federal representative character of our government, in which both representation and direct taxation were apportioned according to population.

The first census, which was taken in 1790, referred only to population. As time went on, however, the scope of the census has been extended so as to include all those statistics which refer to population, births and deaths, manufacturing, transportation, agriculture and mining. Practically all of the people of the United States may be said to be engaged either in agriculture, in manufacturing, in mining, in transportation, in trade, or in rendering personal service. For those comprised in the last two classes there will be no inquiries during the census year which will disclose the extent of their business, the amount of capital which they have invested or the returns which they receive, but for all the other classes mentioned these data will be furnished in addition to those which concern vital statistics. How complete the inquiry is which is now being conducted, and how wide a field of information the data which the census will collect will cover, can only be realized by an inspection of the act of Congress of March 3, 1899, which provided for taking the twelfth and subsequent censuses. The extent of the inquiries, however, may be judged by noting that section which refers to agriculture, and which is as follows: —

The schedule relating to agriculture shall comprehend the following topics: name of occupant of each farm, tenure, acreage, value of farm and improvements, acreage of different products, quantity and value of products, and number and value of live stock.

The work which the census is undertaking to do in collecting statistics of agriculture has also been planned with reference to the work now being carried out by the Department of Agriculture in the annual collection of statistics which it presents in its Year Book. The inquiries of the census are intended to supplement and to make complete these valuable papers.

A most important advance has been made in census work, in the perfection of electrical machines for recording the data gathered. The method is called after its inventor, the Hollerith system. By this method a card some three by six inches is used to record the facts for each person in the United States. A section of this card is reserved for the information brought out by each question on the schedule, and a part of each section is reserved for each possible answer to the question. Thus a narrow strip near the left of each card is reserved for the answer regarding race or color. Five race divisions are recognized, namely, white, black, Chinese, Japanese and Indian. Entry is made on the card by punching a hole in the proper place.

In the case of the present census the tabulating card will be used not only for each person but for each family, and will give the age of the family, number of children, the occupation of the various members and other relating statistics.

Without going further into detailed description of what the census undertakes to do, it will be evident, from what I have said, that the information collected will not only enable us to judge of our progress in wealth, in population, in agriculture and in mining, but also it will enable us to compare our own progress and our own development with that of other nations; and that, moreover, the information is sufficiently full and sufficiently definite to furnish in large measure a comparison of the progress and success of various occupations.

It is too early as yet to give the results of all these inquiries, as determined by the census which has been taken during the present year. We have, however, the final results in population, and approximate results are to be had with regard to other lines in inquiry. The census has issued

already a series of bulletins with regard to these first determined data. From these, and from the information which the officers of the census have been kind enough to furnish me, I am able to present to you certain comparisons between the results of 1900 and the results of former censuses; and, while these are not definitive, they are sufficiently accurate for the purpose of drawing general conclusions. My purpose, as I am glad to state again more specifically, is not so much to present to you the results of a strict analysis of certain statistics as it is to call your attention to the great mass of information which the government is here gathering for the use of all its citizens, and to emphasize the fact that when it appears in complete form it will furnish to men of all classes data of the highest interest, not only for determining our standing with respect to other nations, but also for determining something of the opportunities which each individual has in the field of energy to which he has applied himself. The value of these great sources of information which the government furnishes with so liberal a hand is not always understood, and I beg to commend to you a study of the results of the twelfth census when those results appear in their final form. You will, therefore, consider that to-day I am not giving you the real results of the twelfth census, except in the most general form, but I am simply pointing you to that valuable collection of statistics when it is ready for your use. In other words, I am giving you to-night not the feast itself, but simply the menu card.

First of all, the cursory inspection of the census, in comparison with those of other nations, cannot fail to impress one with the strength and power of this country. Several considerations enter when one undertakes to estimate the relative places of the great world powers. One must consider not only the number of separate units which compose the population, but the efficiency and potential of the particular unit, and, finally, the organization which can wield these units effectively. Considered from the first two points of view, the United States is doubtless the most powerful nation on earth; for, although her population is less than that of Russia, which now has 136,000,000 people, the inferiority of the units is so great that the pre-eminence of the

United States cannot be questioned. In strength, as compared the one with the other, the great world powers would be arranged in the following order: the United States, Great Britain, Russia and Germany of equal strength, with France a doubtful fifth. This, in fact, is the order which Sir Robert Giffen, statistician to the English Board of Trade, admits.

Lest, however, this superiority on land should make us unduly boastful, we may well look for a moment at the tonnage of the navies of the world, as recently compiled by the Navy Department. Arranged in the order of naval supremacy, the great nations would stand: England, France, Russia, United States, Germany, Italy, Japan, — with England so enormously in the lead as to equal the strength of her three nearest competitors, France, Russia and the United States. An exhibit of the commercial marine would be even less likely to minister to our self-glorification. On the great lakes we have an enormous tonnage, where we have no competition; but in the open sea, where the nations of the world are free to compete, we cut a figure so small that it is hardly worth while to repeat the actual figures. They do not sound well to American ears. Let us hope that the decade just beginning may tell a different story, and that our ships of commerce may once more carry the American flag to as many quarters of the world as they did in the palmy days of American shipping.

Taking up, briefly, the separate items upon which the census will throw light, let us consider them with respect to the developments of former decades. During the decade ending 1900, the annual increase of wealth was closely that which held between 1880 and 1890. The total wealth of the country will reach approximately 90,000 millions of dollars, and the average wealth for each inhabitant will amount to $1,200. The growth of wealth in New England has apparently not kept pace with the population, while in the Middle States each inhabitant seems to have gained a slight increase. The general increase for the Union is, approximately, $155 per head. In California the average wealth per inhabitant is approximately $2,500, while in Massachusetts the average wealth is $1,080, which is a slight decrease, compared with the average wealth of citizens of Massachusetts in 1890.

The data concerning public schools and public education will form one of the interesting divisions of the work of the twelfth census. The school population in 1900 is approximately 22,300,000, with an average attendance of a little over 11,000,000, and with an annual expenditure for education of something like $210,000,000. The average attendance daily is now 48 per cent, whereas thirty years ago it was only a little over 30 per cent, showing that enormous strides have been made in thirty years in the matter of public education. Thus, while the population of school age has advanced only 85 per cent, the average school attendance has risen 175 per cent. As in former censuses, it will be seen that New England has the most liberal expenditure, while the schools of Southern States still show a meagre support.

In this connection let me add a word as to agricultural education in the United States. I have already suggested that the census statistics in agriculture are supplementary to those gathered by the Department of Agriculture, and which are presented in the Annual Year Book. The Year Book for 1899, which has just been distributed, presents to the reader a most interesting account of the development of agriculture in the United States during the nineteenth century, and of its condition at this closing year of the century. Among other subjects treated in this Year Book is that of agricultural education and the attempts which have been made to introduce instruction in agriculture into elementary rural schools. The report shows that these attempts have been practical failures. A new movement, however, has recently been started by the College of Agriculture at Cornell University, and by other State colleges, for the introduction of what are called "nature studies" into the elementary schools. To accomplish the object aimed at, which is to call attention early in the student's life to the practical problems of agriculture and to the help which science may give in the solution of these problems, object-leaflets, containing suitable matter for lessons, have been issued, and model lessons are given in the schools by travelling inspectors. Up to the present time, however, little has been done toward the establishment of second-grade agricultural schools, and agricultural subjects are as yet not taught in the high schools.

In the United States the State college, with the experiment station attached to it, have been the prime movers in agricultural education. In this connection I venture to quote a private letter, received a few days ago, from the Secretary of Agriculture: —

Permit me to say one thing, outside of your inquiries, that applies to our work here. In round numbers, half the people of the United States are employed in producing from the soil. Where scientific education is offered by State institutions, some of these young people are going to college. If scientific instruction along the line of their life's work is not offered, they do not go to college. When they do go, these agricultural institutions are giving them something with regard to the soil, the plant and the animal, and other things relating to agriculture. Many of these institutions are making progress and strengthening their courses of study. They are really doing good work toward the helping of young farmers along the lines of their future life work. Their education is weak along certain lines; they perhaps do not get as much literature as they should have. The question is, Are the farmers helped by what they do get? The universities and colleges of the land are doing nothing for that part of the community, including the producers from the soil. They have never considered their cases. They have qualifications for entry into college that absolutely prohibit these young people from going. Not only so, but from the industrial stand-point our great institutions of education do nothing along the line I mention (agricultural education). For that reason, we in this department are encouraging young farmers to go through the agricultural college, get what they can, and after graduation come here, when we give them something along their own line.

I have read this letter for two reasons: first of all, it is from a man, himself a farmer, who is profoundly interested in the advancement of agriculture, and therefore interested in all that helps the farmer; secondly, it voices a sentiment which I think is widespread among farmers, namely, that in some way or other the farmers as a class are not receiving the benefit of the scientific training which has become so marked a feature of the world's progress. This question I do not feel able at this moment to discuss. I do not feel sure in my own mind what the best method is for bringing a technical training within the reach of those who spend their

lives on farms, but this, I think, needs to be emphasized. The last quarter-century has brought into our possession not only a new series of facts, but what may be called a new method. It is generally called the scientific method. This is nothing other than to get possession of the facts, and to apply these in accordance with common sense. All the arts and most of the industries have been practically recast by reason of this scientific development. Manufactures, mining, transportation, all industrial arts, avail themselves freely of the results of modern science. The farmer must do the same thing, if he is to keep pace with the developments in manufactures, in mining and in other directions. A whole series of facts relating to the soil, to the climate, to the life of plants, of insects, to the rotation of crops, are available for his use. The applications of chemistry and botany and geology and zoölogy bear directly upon his work. Of all these things he must avail himself. The twentieth-century farmer must use his head as well as his hands, if he is to keep step with progress. Just how this is to be done is perhaps your problem rather than mine; but the significance of the statements which I have just made will, I am sure, be apparent a few minutes later, in considering the fact that agriculture has failed to advance as rapidly during the past few decades as manufactures, mining or population.

The statistics for agriculture, as collected by the census, are not as yet in final form, but, taken in connection with the publications of the Agricultural Department, a fair estimate may be given. One of the interesting developments of the last thirty years has been the change in the relative size of farms, — a fact which is made more evident by the diagram which I present than it can be by any table of statistics. On the whole, and particularly in the south and west, the average size of farms has diminished greatly since the civil war.

Grain and cotton are the chief products in agriculture. Since 1890 the area employed in the cultivation of these staples has increased 12½ per cent. The value of all farm products, however, including not only those mentioned, but potatoes, hay, tobacco and sugar, will amount, during the current year, to approximately 4,500 millions of dollars,

being at the rate of about $61 for each inhabitant, which is slightly less than that in 1880, which was about $67. The decline is chiefly in the pastoral products, particularly in live stock. Thus in 1880 we raised nearly as many horses, cattle, sheep and pigs as in 1900. The total number of persons engaged in agricultural pursuits is 10½ millions, and their production, therefore, amounts to about $430 per person, as against $2,000 per person engaged in manufactures.

Let us look at it in another light. During the last twenty years population has increased 52 per cent; school population has increased 58 per cent; wealth has increased 109 per cent; manufactures have increased 150 per cent; mining has increased 83 per cent; agriculture has increased only 36 per cent, as measured in the same way, by the value of its products. There is food for serious reflection in these figures. The fact that agriculture has not kept pace, either with population or with other branches of industry, is one that concerns not only those who live on farms, but it concerns as well the whole country. I commend to your consideration the data of the census, which bring out these results, and an intelligent study of the problem as to how the farmer may avail himself, as other men engaged in industry have availed themselves, of the work of modern science.

It goes without saying that this discrepancy between the gain in agriculture and in these industries, for instance, manufactures, is due to a variety of reasons, of which the one to which I have alluded is only one. The enormous growth of manufacturing is also due to a number of causes. But, notwithstanding all this, it is still a fact that agriculture does not seem to have availed itself, as have other industrial branches, of the fruitage which science has brought to the last quarter of the century.

The data which the census will furnish concerning manufactures will be most complete and most interesting. The value of the output in 1900 will show an increase from about 9,300 millions to 13,300 millions of dollars; and the manufacturing hands, in 1900, compose about 9 per cent of the population, as against 7½ per cent in 1890. The separate items which go to make up manufactures will themselves form interesting problems in the growth and in the development of

the nation, but these may be best brought out by study of the final statistics themselves.

Transportation in its various lines of employment occupies the time of a large proportion of the citizens of the country. Naturally we are approaching conditions in which the development of the railroad is slower than during the decade from 1880 to 1890. At the census of 1890 railroads represented 15 per cent of the wealth of the nation; in 1900 they will only stand for about 12½ per cent.

Without asking your attention to the many other lines of inquiry concerning the resources and the productive power of the nation, I will close this brief statement with a few facts concerning the population. The aggregate population, as fixed by the new census, is 76,295,220, as against a trifle more than 63 million ten years ago. The gain is something over 13 millions, or 21 per cent.

There are many interesting developments shown by the figures of the census as to the relative growth of States and of sections. Thus, New York State still remains much the largest in population, having gained the full 21 per cent of increase. All the States, with the exception of Nevada, show increases. That singular State, with large area, with resources for a population of a half million, shows a net decrease of 7½ per cent. There is food here for the political economist who desires to struggle with a real question in economics, which demands a real solution.

Of the larger States, having a population of 1,000,000 and more, the State which makes the smallest gain is Nebraska, whose population increased just 9,991 in ten years, or at the rate of a little less than 1 per cent. It may be that there is also a story here not without interest and not without value, but this is scarcely the time to trace it out. It is significant that the adjoining State of Kansas, with approximately the same population, gained only 3 per cent, while its neighbor on the east, Iowa, gained 18 per cent.

The largest percentages of gain were those of Idaho, Montana and North Dakota, which were respectively 92, 84, and 75 per cent, — a gain in large measure accounted for by the development of new territory. Of the larger States, having populations of 1,000,000 or more, Texas and Minne-

sota show the greatest gain, the former having increased her population 36.4 per cent, and the latter 34.5 per cent. One of these States is at the southern end of the great Mississippi Valley, the other at the northern end. They have wide differences as to climate, soil, population and politics. The result may tend to show that growth depends on many factors.

The increase of population in the territories has been, as might have been expected, far more rapid than elsewhere. Arizona has increased 105 per cent; the Indian Territory, 117 per cent; while Oklahoma shows the enormous gain of 544 per cent. She now has a population ten times that of Nevada, and is knocking vigorously at the doors of Congress for admission to the sisterhood of States.

A glance over the various States of the Union will show a far wider range of percentages of growth among individual States than is to be found between different sections. In general, it may be said that New England, as a whole, has fallen behind the average growth in population. The same thing is true in a less degree of the southern States. The middle States have kept up about the average percentage of growth, while the western States have grown far faster than the average. Thus the average growth in population in New England has been 14.7 per cent. In the middle States, including New York, New Jersey, Pennsylvania, Delaware, Maryland and the District of Columbia, the gain has been 21 per cent. In the southern States, including the two Virginias, the two Carolinas, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Louisiana, Texas and Arkansas, the gain has been 20.5 per cent. With regard to New England, it is to be noted that one group of States, Maine, New Hampshire and Vermont, the agricultural group, are far below the average, their growth in population being only 5.8 per cent; while the other group, Massachusetts, Rhode Island and Connecticut, the manufacturing group, are above the average, their average growth being 23.7 per cent. Massachusetts leads all the New England States, with a percentage of 25.3. This short comparison serves to emphasize the fact that particular advantages for manufacture, for commerce or for agriculture, will largely

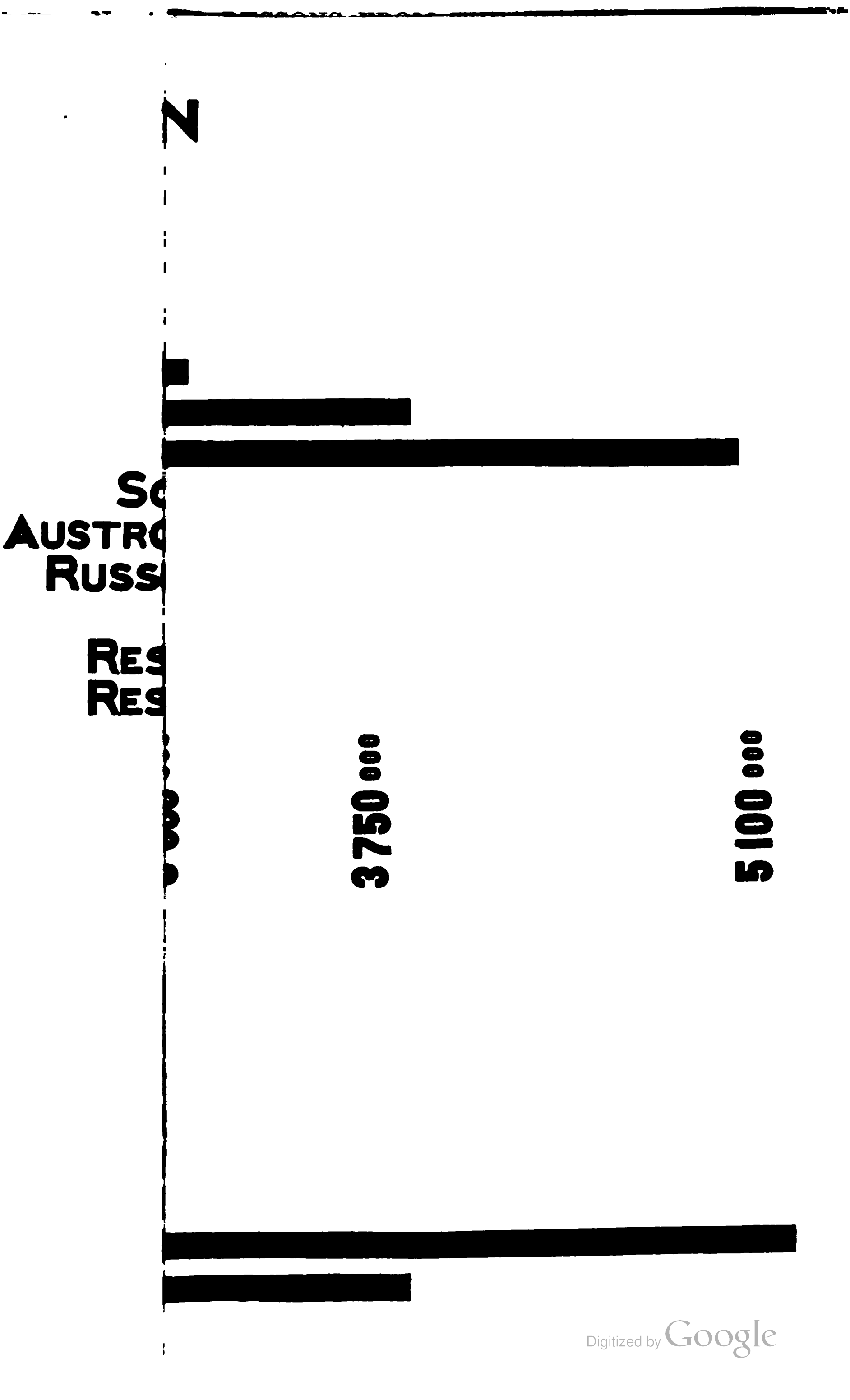
change the growth of different localities. A comparison of birth rate in these separate States will go far to show what has been the emigration from one State to another, and how largely this factor affects the growth which we have seen.

A significant item from the new census, and one which calls to mind the stirring events of the last few years, is that which records the population of Hawaii. A bulletin of the census just issued gives the population of that new territory, as of June 1 last, 154,001. This shows a growth of 41 per cent since the census taken in 1896, and is the largest percentage of growth indicated in any of the twelve censuses of the islands taken since 1832. There was, in fact, a steady decline in population between 1850 and 1870. During the forty-three years ending in 1896, the pure-blood natives had decreased from 71,000 to 39,500, and there is no reason to believe that this decline has been checked. The causes of it are the same as those which have decimated other islands of the Pacific. The native Hawaiians, as most aboriginal peoples, are very susceptible to contagious diseases. One-fourth of them died of measles in 1848, and they are great sufferers from leprosy, although this dreadful disease is now being held in check, and there is good prospect that it will be stamped out altogether. The largest cause, however, for the decrease in numbers is the growing frequency of marriage with foreigners, — Chinese, Japanese, Portuguese and Americans. The Hawaiians are destined to lose their identity as a distinct branch of the Polynesian people, and the increase in population which has been noted is due entirely to the influx of foreigners from Asia, America and Europe. The only city of the island of any size is Honolulu, which now has a population of 39,306 persons, and has nearly doubled in the last decade. To-day it is the metropolis of the central Pacific, the great way station at which converge the routes between Asia and Australia on the one hand, and America on the other. The government of Hawaii, as a Territory of the Union, is a problem in administration whose solution will be watched with great interest. The government instituted there last March, in consequence of the passage of the territorial bill through the two branches of Congress, took

the place of one of the best examples of administrative republican government in existence, and it will be a source of no small degree of shame to us if the Hawaiians have cause to regret the change of events which brought them into the sovereignty of the United States.

It is too soon to give the final results of the twelfth census relative to immigration, birth rate and other vital statistics concerning the population. From the annual reports, however, of immigration, it is possible to know very closely the rate of immigration from year to year, and the sections of the country whither the streams of incoming foreigners flow. The graphical representation which I show you conveys in a moment's study what a large collection of figures would show less distinctly. It gives the result from year to year of immigration into the United States since 1820, starting from about 38,000 at the first period, reaching a maximum in 1882 of nearly 800,000, and showing a fairly regular diminution since. At the present time, again, immigration seems to be increasing, and during the present year will amount to something over 420,000. The total immigration since 1820, by races, is shown on the chart next following. The Germans have furnished our greatest source of supply, over 5,000,000 having entered the country since 1820. Next in order are the Irish, British, Scandinavians, Austro-Hungarians and Italians. Their respective immigration, however, can be seen better from the diagram itself than from any description.

How great a change has taken place in the last thirty years in the character of this immigration will be evident from a study of the next diagram. It shows, in brief, that the percentage of immigration from Great Britain, Ireland and Scandinavia has steadily diminished during the last fifteen years. The immigration of Russians has on the whole remained constant, while the Italians have been coming in vastly greater numbers, and now form a very large proportion of the total immigration; and that, whereas fifteen years ago over 50 per cent of the total immigration came from Great Britain, Germany and Scandinavia, to-day those countries furnish only about 43 per cent of the total immigration. The distribution of this foreign population among the separate States is shown in the next diagram, in which the States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are arranged in the order of their proportion of native-born white citizens.

Another classification of interest, as showing the directions in which the energy of this imported population goes, is shown by the next diagram, which gives a classification of wage earners as shown in 1890, both for native whites, for foreign born, and for negroes.

The seven great States of the Union in point of population are, in order, New York, Pennsylvania, Illinois, Ohio, Missouri, Texas and Massachusetts. In this group Ohio has, since the last census, been displaced by Illinois, and Massachusetts has had to give place to Texas. The great States have, on the whole, grown at about the average rate, their percentage of increase being 21.7.

The general result of an examination of the census returns can but be favorable to American pride and American hopefulness. The country is growing in strength and in wealth at an enormous rate. Every day shows an addition to the population of 4,000, increases the number of school children by 800, adds 29,000 acres to the cultivated farms, shows an increase of $1,000,000 in manufactures, and contributes 7½ million dollars to the national wealth. These figures are striking, and the numberless small streams which go to make up this total in population, in wealth, in resources, come from many directions. A study of their sources and of their character may well form a part of the equipment of the student, as well as afford the basis of practical decisions to the manufacturer, the farmer and to all others engaged in practical affairs.

As incomplete as this review of the work of the census has been, it cannot fail, I think, to call to your attention the fact that this great collection of material furnishes abundant food for thought for the serious man, whether he belongs to one of the professions, whether he is in agriculture or in manufactures, whether he is in a trade or a private business of his own, and whether he is native born or a son of the country by adoption. Furthermore, problems which are here suggested are not alone those which refer to material advancement, to the increase of wealth, to the development of agriculture, manufactures or the arts; they have to do,

likewise, with the quality of our citizenship and the perpetuation of our institutions. The character of that great stream of immigration, of which I have just spoken, and its effect upon the industrial and social life of the nation, are of great concern alike to native born and to the immigrant himself. There has been much foolish talk, by those who appeal to class prejudice, concerning the "ignorant foreigner." Very little has been said, on the other hand, concerning the intelligent, the industrious, the patriotic foreigner. Very little acknowledgment has been made of the debt which this country owes to the men who have come from other shores, and who have brought here strength and energy and devotion to our institutions. No one can doubt that the stream of new blood which has been poured into our national life has contributed in no small measure to the strength of the American character. Nothing has been more wonderful in the growth of nations than the way in which this alien population has been absorbed and has become a part of the very life of the nation. And no study of American life and of American habits can be complete without reckoning with the influence upon it of those who have come from Great Britain, Germany, Scandinavia and all other countries of the world, to share with us the problems of developing a great continent. In determining this influence one must reckon not only with the inflow of foreign settlers, but also with the outflow. And such an examination shows that certain nations of Europe send us permanent settlers, while others send emigrants whose stay is but temporary, some who become citizens and some who do not. This quality and many others enter when one undertakes to determine the effect upon the country at large and upon its institutions by the inflow of emigrants from other nations. Whatever one may think of the effect which this or that nationality may impart, it must be evident that America has helped to solve not only her own problems but the problems of European nations as well. How far she may choose in the future to hold open to Europe an unrestricted entrance to her domain and to her citizenship is one of the problems to be seriously thought out.

On our western coast the continent of North America

faces Asia, as our Atlantic sea-board faces Europe; and the problems of Asiatic life and of Asiatic institutions have been injected into the economic possibilities of the Pacific coast States. No one can doubt that in some way or other the Pacific coast is to share the problems of Asia, as our Atlantic coast has shared those of Europe.

I was never more impressed with the possibilities of American citizenship than while witnessing in San Francisco, in August, 1899, the reception given to the Californian troops returning from the Philippines. California and San Francisco fairly outdid themselves in welcoming their returning sons. Every organization among the citizens was represented in the column which welcomed the returning soldiers. The Society of the Native Sons of California — Native Sons of the Golden West, as they call themselves — turned out its thousands to swell the throng. Among these native sons was a regiment of Chinamen, American citizens, born in the United States, marching step to step with other citizens born in California. They showed their full share of enthusiasm, took their full part in welcoming those returning from the Asiatic campaign, and paid more than their share of the expense. Fifteen years before, such a demonstration would not have been permitted in the streets of San Francisco; and the interest, enthusiasm and devotion of these Chinese citizens to American ideals and American institutions were full of suggestions as to the possibilities of American citizenship and as to the final form of civilization which will become permanent on this continent.

I mention this incident, not to suggest an unrestricted admission of Chinese into the United States, but to call attention to the fact that the problem of civilization in these United States of America is not to be wrought out without some regard to Europe and to Asia. No man lives to himself, and still less does any nation, — least of all that in which we have the good fortune to live. There are those who, when they speak of all mankind, include only the inhabitants of their native city; to others the term means the dwellers in a single Commonwealth; a still larger number have in mind, when they use this term, the inhabitants of the United States, and particularly the native born. But the

man who believes in the ultimate greatness of his country, in the permanence of its institutions and the part which it is to take in the upbuilding of civilization, limits mankind to no race, to no country and to no climate. Such an one sees, in the far-reaching problems which stand before the American people, issues more important than those which concern a single nation or a single race. Out of the successful solution of these problems is to come that which, while conserving the interests of the United States, will take into account the interest of the world and the happiness of mankind. Whatever the result of the statesmanship of the next hundred years, whatever laws may be enacted, whether they be wise or unwise, the government and the civilization which will persist will be neither that of New England, nor of the South, nor of the West, nor will it be European or Asiatic or African; but it will be a combination of all these. Fortunate will it be if the nation finds leaders sufficiently patriotic and sufficiently far-seeing to deal with these questions from the highest stand-point. Already it is evident that higher considerations than those of mere material gain or even of national greatness are moving in the minds of thoughtful men. It is one of the evidences of that larger life into which as a nation we are coming. It helps us to realize that he spoke truly who said: —

> Through the ages one *increasing* purpose runs,
> And the thoughts of men *are* widened by the process of the suns.

SECOND DAY.

The meeting was called together at 10.30 A.M. by First Vice-President Sessions, who said: The lecture this morning is on "Fungous diseases." Those of you who are growing fruits and dealing with the finer parts of agriculture, such as market gardening, know very well that this subject is a very important one. As we have progressed and advanced in our work from year to year we have found these obstacles that have hindered our work and have been a serious detriment to our success. The lecturer has given years of study to this subject, and comes before us as well equipped as any man whom the Board of Agriculture could procure to speak on this subject. Dr. Wm. C. Sturgis, botanist, Connecticut Agricultural Experiment Station, will now address us.

FUNGOUS DISEASES.

BY DR. WM. C. STURGIS, NEW HAVEN, CONN.

The subject upon which I have been asked to address you is not a new one. For the past fifty years plant-diseases caused by the attacks of parasitic fungi have occupied, in an ever-increasing degree, the time and attention of scientists. The student of vegetable physiology can no longer confine himself to a study of the normal processes of assimilation, growth and reproduction, as exhibited in the world of the higher plants, for he finds that those functions are constantly being disturbed by external agencies, and that among such agencies are to be reckoned a host of lower plants which prey upon the higher, and by their attacks produce a profound disturbance of the normal activities. In other words, he is confronted with abnormal conditions, which, by analogy, he rightly calls disease. Thus there has arisen a comparatively recent demand for specialists, — men of scientific training, thoroughly informed on the subject of the normal structure and life-processes of the higher plants, able to discern the smallest deviation from the normal course of plant-life, and sufficiently conversant with the many external agencies which may disturb that course, as to be enabled to diagnose the special case under consideration and to suggest a remedy.

Such is the modern student of vegetable pathology. He is to the plant-world what the physician is to the animal-world; and if, as is certainly the case at present, he succeeds in winning less regard for and support in his work, it is largely because the public, and particularly the farmers of the country, have but an inadequate conception of the vast amount of damage caused annually by plant-diseases, their extraordinary prevalence, and the incalculable benefits to agriculture which have, during the past quarter-century,

marked the application of preventive measures suggested by the vegetable pathologist. Slowly, however, the latter is gaining recognition from practical men. He is no longer regarded as altogether an airy theorist, or, in the common parlance, a mere "book-farmer;" and, on the other hand, he is gaining consideration as something more than a "plant doctor" or "bug man." Even the less intelligent and progressive farmer is learning that, in order to grow a sound and healthy crop of fruit, some attention must be paid to the needs of the trees in the way of abundant nutriment, a healthy environment and constant tillage; that, even if these conditions are fulfilled, he must guard against the attacks of insects which may ruin his fruit or otherwise curtail his profits; and, finally, that he must take measures to prevent a host of ills formerly attributed to the weather, to "hard luck," or the over-rulings of a hostile Providence, when, as a matter of fact, in nine cases out of ten, they are caused by parasitic fungi over which he may exercise a fair measure of control. The vegetable pathologist, then, has to deal with two main causes of plant-disease; the one due to defective methods of cultivation; the other, to parasitic attacks on the part of either insects or fungi, or both.

It is to the last-named topic, the fungous diseases of plants, that I desire to call your attention particularly. I am fully aware that to many of you this is a familiar topic. But, inasmuch as it is to those to whom it is unfamiliar that I desire, if possible, to make my subject clear, I may perhaps be pardoned for considering somewhat at length the nature of those lowly organisms which we call fungi.

At the outset let me say that a fungus is as truly a plant as is an elm tree. It is not an animal or an insect; it is not the spontaneous product of wet weather. Like the higher plants, it absorbs nutriment, it grows under favorable conditions of warmth and moisture, it reproduces itself by bodies analogous to seeds or by vegetative portions analogous to cuttings. But a fungus differs from a higher plant in several particulars. Usually it is very small, often of microscopic size; its organization is less complex; it has no true root, stem or leaves. Above all, it produces no true seeds and it possesses none of the green coloring matter distinctive of

most flowering plants. These points of difference are important. The seed of a flowering plant consists essentially of a small embryo, usually surrounded by a mass of starchy matter, and enclosed in protective coats. It is a complex body. In fungi there are no flowers, and in place of seeds we find very minute spherical or elongated bodies, containing no embryo, and of very simple structure. They are known as *spores*.

Most of the higher plants are provided with a green coloring matter, contained in small spherical bodies within the cells, and known as *chlorophyl*. By means of this chlorophyl the plant is enabled to transform such inorganic substances as carbon, oxygen, hydrogen, nitrogen and the various chemical salts which it takes up from the air and water, into organic substances such as starch, gum, resin, sugar and the like. Fungi, possessing no chlorophyl, are unable to do this. Like animals, they must depend for their nutrition upon organic matter already prepared by living organisms. They may derive their nutriment from the substance of either living or dead plants or animals. In the former case they are called *parasites*, in the latter *saprophytes*. It is to the faculty of growing as parasites that fungi owe their importance as causes of disease. Growing upon the leaves of a living plant, they penetrate the tissues and absorb from them the organic matter which the plant has prepared for its own use and without which it cannot thrive. A diseased condition of the part attacked, often ending in death, is the result.

Yet, in comparison with the plant attacked, and known as the *host*, the parasitic fungus is of insignificant size, often hardly visible to the naked eye. This smallness of size is by no means characteristic of all fungi; they vary greatly in this respect. The fungus forming the bluish-green mold on damp bread, old shoes, etc., and those which, under the common names of "scab," "blight," "rust," "smut," "mildew," etc., infest and damage our crops, are so minute as to necessitate the use of a powerful microscope for their study. On the other hand, every one is familiar with the large fungi known as "toadstools," "mushrooms" and "puff-balls," which occur so abundantly in our woods and fields. These are sometimes very large, puff-balls having been found,

a single one of which would fill a bushel-basket. Between these two extremes is a host of fungous forms, numbering over forty thousand species and presenting the most astonishing variety and beauty of form, though in microscopic proportions. All of these species, of whatever size or form, are characterized by the fact that they can live only upon organic matter, and that they are reproduced by means of minute bodies of simple structure, called spores. What the spores of fungi lack in size they make up in quantity. The number of spores contained within a small puff-ball, and issuing in the form of an impalpable dust, is almost incredible. The same is true of the familiar fungus producing "smut" on corn; the top of a pen knife dipped into this black mass will come away loaded with over one million spores.

With the aid of a good microscope we can see how a fungous spore germinates and to what it gives rise. If spores of the common bread-mold be placed under conditions suitable to their development, they each produce at one point on the surface a delicate transparent tube, which grows rapidly, branches profusely, and soon overruns and permeates the substance upon which the spores have been sown. Sometimes, as in the case of the larger fungi, these minute tubes are produced so luxuriantly that they form white strands, visible to the naked eye. Such is the "spawn" familiar to growers of mushrooms. In the case of the parasitic fungi, however, these tubes are seldom visible, both by reason of their minute size and the fact that they are usually buried in the substance of the fruit, leaf or stem upon which the fungus is growing.

Sooner or later, sometimes in the course of a few hours after the germination of the spore, these vegetative threads send up erect branches to the surface, and on the tips of these branches a fresh crop of spores is produced. These fall off readily, are swept up by currents of air or water, or are carried by birds or insects to neighboring plants; there they germinate, and the process is repeated so long as the conditions are favorable. Often as many as ten generations of spores may thus be produced in a single summer; and when we consider the vast number of spores represented by each

generation, and the fact that theoretically each single spore is able to reproduce the fungus, as a seed does the plant to which it belongs, the wonder is, not that there are so many fungous diseases of plants, but that any plants escape the attacks of these minute but ubiquitous parasites. Nor would they, except for certain features characteristic of the fungi themselves. The first is the comparatively small number of strictly parasitic fungi and the partiality shown by most of these for a certain species or group of species of plants. This in itself is a mighty safeguard. Thus the fungus which causes the "smut" of onions will not attack corn; the "downy mildew" of lima beans is limited absolutely, so far as I know, to that one plant; the "leaf-spot" of the strawberry cannot be transferred even to so nearly related a plant as the blackberry. Similar instances might be cited almost indefinitely. So limited are the preferences of parasitic fungi that it is possible to arrange them in a fairly satisfactory artificial system, according to the host-plants which they severally affect. It is evident that in this fact is to be found one cause for the limited spread of fungous diseases.

Another though far less important factor is the extreme delicacy of that particular form of reproductive bodies which I have spoken of as spores. Since they are borne freely exposed to the air and are produced only during the summer, they might more properly be called summer or aërial spores. Though borne in countless multitudes, characterized by such minuteness that the slightest breath of wind carries them hither and thither often over great distances, requiring but the thinnest film of water for their germination and growth, and therefore being able, under favorable conditions, to cause the rapid spread of disease, sometimes over a large area in the course of a few days, as in the case of the "potato mildew," yet the delicacy of these summer spores is such that they cannot long withstand conditions adverse to their development. Some degree of moisture, however slight, is essential; hence we find that the spread of fungous diseases is more rapid in damp, close or foggy weather than when the air is dry. Let the latter condition prevail, and the summer spores will perish unless protected. This result of course occurs more frequently where sunshine and air have free

access than where they are shut off by the density of the foliage; hence, as a rule, parasitic fungi attack more readily plants with a dense leafage or of a low, reclining habit than those of an erect habit and of thinner leafage. This fact is well attested by the comparative freedom from disease of tomato plants, tied upright to stakes and trained to a single stem, over the same plants permitted to grow as they please in dense masses close to the ground. Again, the summer spores have no means for successfully resisting low temperatures. Summer is pre-eminently their season, and, though they may occasionally resist the cold of the winter if covered over in leaf heaps or otherwise protected, as a general thing the first hard frosts mean their destruction. The burning of dead leaves, which might harbor them, has, therefore, more than an æsthetic value.

It is very evident, then, that there are several very salutary checks upon the universal prevalence of fungous diseases; so much so, in fact, that we are led to wonder how it happens that any parasitic fungus requiring a host-plant in active life, and a fair degree of warmth and moisture, is ever able to resist the winter. Let us see how this is effected.

I have heretofore spoken of the summer spores exclusively, and have perhaps given the impression that they constitute the sole means of fungous reproduction. This, however, is by no means the case. In many if not most of the common parasitic fungi there are formed, by the intertwining and massing together of the vegetative threads, small globular receptacles, varying in size, but usually somewhat smaller than a pin head. The walls of the cells composing these receptacles become hard and black, and within the latter, on the approach of cold weather, are formed numbers of little club-shaped sacs, each one containing a small number of spores. Sometimes these receptacles are completely closed, and they never have more than a minute opening at the top. They form a perfect means of protection from cold and drought for the spores borne within them, and thus the fungus is enabled to pass successfully through the winter. During that period the leaves, fruit or twigs upon which this form of the fungus is borne, gradually decay, and with the advent of the warm spring rains the contents of the receptacles absorb water

and swell up, thus forcing the spores out through the opening in the top. Carried by the wind or other agencies to the young foliage of the budding trees, they germinate, force their way into the succulent tissues, and finally produce the first crop of summer spores upon the leaves or twigs. Familiar examples of such winter spores are seen in the strawberry blight, the powdery mildews, and the black-rot of grapes.

Again, some fungi produce, late in the season and generally within and therefore protected by the tissues of the plant, peculiar roundish bodies, called *resting spores*, from the fact that, unlike the summer spores, they require a period of rest, after they have reached maturity, before they will germinate. These resting spores may be formed either from a small portion of one of the vegetative threads, which swells slightly and takes on a hard, thick wall, or, as in the case of the downy mildews, from a special form of fruiting branch, the tip of which swells up into a globular vesicle, containing a single large spore with a very dense wall, buried in the tissues of the host-plant. As contrasted with the minute and short-lived summer spores, the winter and resting spores are large and few in number, but their thick walls and protective surroundings enable them to resist extremes of cold and drought fatal to the other forms, and they thus serve in many cases to carry the fungi over the winter. With the approach of warm weather they start into growth again, and either directly or indirectly give rise to a crop of summer spores.

Some fungi, however, possess neither of these forms of resistant spores, and other methods are resorted to, to maintain vitality. The vegetative threads of some fungi when placed under conditions unfavorable to growth, become twisted into dense knots of a solid consistency and with a hard, black exterior. These knots are known as *sclerotia*, and are sometimes as large as a kernel of corn. Familiar examples of sclerotia are seen in the "ergot" of rye and in the rot of lettuce grown under glass. They are extremely resistant, and maintain their vitality sometimes for years.

In the case of other fungi the vegetative threads are perennial in the tissues of the plant affected, and in such cases

often produce peculiar swellings or distortions, within which the threads remain concealed and protected during the winter, ready to spring into pernicious activity as soon as conditions are favorable to growth. Such perennial vegetative threads are found in the swellings on the twigs of plum and cherry trees, known as "black-knot," and in the mummified fruits of the peach affected with fruit mold.

To recapitulate, fungi are minute plants, which, owing to a lack of chlorophyl, are obliged to depend upon organic food-material of vegetable or animal origin. They may derive their nutriment from the living tissues of the higher plants, in which case they are called parasites. Their vegetative portion consists of delicate tubes, which, in the case of the parasitic fungi, traverse the living tissues of the host-plant, and by absorbing the contents of the latter, produce symptoms of disease. During the summer they are propagated by means of multitudes of very small, delicate spores, borne on aërial threads. They maintain their vitality during the winter by means of spores similar to the summer spores, but enclosed in dense receptacles; by larger, thick-walled winter spores; or by the vegetative threads themselves, which either exist perennially within the tissues of the host-plant or else form small, solid knots, with thick external walls. From any of these forms the summer spores may be reproduced with the return of warm weather.

I have dealt thus fully with the nature of parasitic fungi, because an understanding of this matter is at the foundation of all methods of preventive treatment of fungous diseases. One further point, however, is deserving of note in this connection. It is, of course, the vegetative portion of a fungus which does the damage to the plant, and this damage is wrought in a variety of ways, largely dependent upon the location of the threads within the portion of the plant attacked and their effect upon the tissues. They may be deeply buried, and produce the decay or complete destruction of the tissues, as in the "rot" of potatoes and the "smut" of cereals and onions; or they may infest only the surface tissues, and, without destroying them or causing decay, prevent their full development, as is seen in the scab of apples and in most so-called "leaf-spot" diseases; or,

finally, they may be wholly external, producing no change whatever in the tissues, but causing a diseased condition of the whole leaf attacked, by cutting off the free supply of air and by absorbing the juices from the external tissues.

All these facts must be studied before we are prepared to recommend any definite line of treatment. Having, however, ascertained the cause of a certain disease to be a specific parasitic fungus, and having observed the location of the parasite, its course of development and its methods of reproduction, we can with a fair degree of assurance take measures to prevent it. I purposely use the word "prevent" rather than "cure," for, while we can prevent the inception or the recurrence of a disease with a fair degree of certainty, it is almost impossible to cure it, after the fungus has become established within the tissues, by any means short of the destruction of the parts affected.

There are two definite lines of treatment of fungous diseases: the one hygienic, aiming to eradicate disease by the alteration of external conditions conducive to its spread; the other consisting in the application, to the parts endangered, of some substance inimical to fungous growth.

Enough has been said regarding the nature and life history of fungi to show you that if we can destroy both the spores and the vegetative threads of a fungus, while those organs are either dormant or have not yet reached maturity, we shall get at the root of the whole matter. Here a little common-sense is of great assistance. Fruit rots and falls prematurely, usually because it has been attacked by a parasitic fungus; the same agency causes leaves to blight and fall from the trees. Such fruit and leaves are allowed to remain where they fall, because they are of no use. But the fungus within their tissues remains protected during the winter, develops slowly, and, with the approach of warm weather, produces its spores in vast numbers, each spore able to reproduce the fungus upon the budding leaves and young fruit of the tree immediately above it, if a slight breeze should cause it to lodge there. No preventive treatment of any nature in spring or summer will protect completely fruit and leaves so wantonly exposed to disease. If the rotten fruit be not allowed to remain where it falls, it is usually fed to the pigs. The spores of the

fungus pass uninjured through the alimentary canal of the animals, are carried with the manure to the compost heap, and thence are spread broadcast over our fields and orchards; and then we wonder that our summer treatment of the trees with fungicides is of so little avail. The only reasonable method to pursue is to gather carefully at the time of harvest, and at once burn, all diseased fruit and leaves.

But, as you know, fungi are not reproduced entirely by their spores. In a great many cases the vegetative portion exists perennially in the twigs and branches attacked, as well as in the discarded fruit, and is capable of propagating the fungus upon the return of favorable conditions. In the former case the unsparing use of the pruning knife is the only reasonable cure. Familiar examples of such are the "black-knot" of plum and cherry trees, in which case it is only necessary to watch the growth of one of the "knots" from year to year to convince yourselves that it renews itself annually from within the tissues of the branch; the dreaded "anthracnose" of raspberries, grape vines, etc.; also all of our more common "rust" fungi. Only by cutting out and burning all diseased tissue can such diseases be eradicated. The destruction of wild plants which harbor dangerous parasites is another point of hygienic importance. Thus we can best protect our cherries from "black-knot" by destroying neighboring wild cherry trees infected with the disease, while the "rust" of apple leaves may be completely eradicated by the destruction of adjacent red cedars, which harbor, in a peculiar form, the winter stage of the fungus.

Furthermore, most fungi require a considerable degree of moisture for their most rapid development. An unusually warm, damp season is accompanied by great fungous activity, and plants containing much water are peculiarly liable to fungous attack. This is perhaps more noticeable, and at the same time more readily controlled, in the greenhouse than in the field. In such cases thorough drainage, and the training of the plants so as to secure free ventilation and the access of air and sunlight, will do more to prevent diseased conditions than any fungicide.

I would also call your attention, in this connection, to the advisability of producing and selecting varieties of fruits,

etc., which are resistant to disease. I am convinced that in recent years we have limited ourselves too exclusively to the selection of varieties along the line of fruitage. The result has been a serious impairment of the constitutional vigor and the resistant qualities of the stock. To my mind, this is one explanation of the surprising increase of fungous diseases during the past few years.

Finally, the judicious use of chemical fertilizers has an appreciable effect upon the prevalence of fungous diseases, both directly and indirectly. It is a well-known fact that the fungus causing the "scab" of potatoes is able to live and thrive in the manure heap. Scabby potatoes fed to stock account for its presence there, whence it is carried directly to the seed potatoes. The use of chemical fertilizers evidently offers a means of preventing infection from this source. Moreover, the tendency of highly nitrogenous fertilizers is to produce a soft, succulent, ill-ripened growth, which succumbs readily to the attacks of fungi. It is evidently advisable to balance this tendency by the use of fertilizers rich in potash and phosphoric acid, whereby firm, resistant tissues are secured.

I believe that these hygienic and cultural methods of dealing with fungous diseases are deserving of far more attention than they usually receive on the part of men who are farming for profit, and that in many instances practical immunity can be secured by them without the labor and expense of spraying. I should, however, belie my own experience were I to detract from the value of fungicides intelligently used. The case is much the same as with human beings. Ordinarily a person can maintain a condition of sound health so long as he obeys a few definite principles of hygiene, and keeps his surroundings in a clean and sanitary condition. Nevertheless, occasions will arise, owing perhaps to some constitutional weakness or to the sporadic appearance of a specific disease, when recourse must be had to medical treatment. So it is in the case of vegetable pathology, and nowadays facilities for spraying with fungicides have become an essential feature of farm and orchard practice.

For convenience, we may divide fungicides into three classes, — liquids, powders and vapors. Of these, the first

and second alone are adapted to field work, while the third is invaluable in the greenhouse or any enclosed space. Let us consider first the liquids.

The salts of copper exercise, when applied in sufficient quantity, a most harmful effect upon all vegetation, the cheapest and most convenient form being the sulphate, commonly known as "blue vitriol." The delicate nature of fungi renders them peculiarly susceptible to the action of this chemical, recent laboratory experiments which I have been conducting showing that comparatively resistant fungous spores failed completely to germinate in water containing only .03 of one per cent of copper sulphate. If, therefore, a solution containing one pound of copper sulphate to twenty-five gallons of water be sprayed upon fungi or their spores, many of the latter will be killed. We act upon this principle in our preliminary or winter spraying. In March or early April, before the buds have begun to swell, we give the trees and the subjacent ground a thorough spraying with a simple solution of copper sulphate made in the proportions just mentioned. The spores which have developed in the refuse lying on the ground, or which have lodged in the cracks and crevices of the bark, are thus largely destroyed. We start with our orchard or garden comparatively free from the germs of disease, and have only to persuade our neighbors to exercise the same sensible precaution. Unfortunately, despite all our efforts, fungi will appear later to some degree. If, when the trees are in full leaf, we should treat them with the strong solution of copper sulphate, we should indeed prevent fungous attack, but only by destroying the foliage. It is therefore necessary, at this stage, to use some other salt of copper, preferably an insoluble one. Fortunately, it is a simple matter to transform copper sulphate in solution into the insoluble hydrate of copper, by merely adding to it a whitewash made of ordinary stone lime. If enough of this is added, all of the sulphate is changed to the hydrate, which remains suspended in the liquid. This is the famous Bordeaux mixture, the most generally useful of all known fungicides. The simplest method of preparation is as follows: Dissolve five pounds of granulated copper sulphate in twenty-five gallons of water. Slake five pounds

of good stone lime in a little water, and when thoroughly slaked add enough water to make twenty-five gallons. When cool, pour the two solutions together rapidly into a fifty-gallon cask, and stir thoroughly. The turbid, sky-blue mixture which results should be used within twelve hours after it is prepared.

Another excellent fungicide, especially valuable in cases where the unsightly spotting caused by the use of Bordeaux mixture is to be avoided, is the ammonia solution of copper carbonate. This is prepared by adding to eight parts of water one part of strong ammonia, and suspending in this a quantity of copper carbonate. Within a few hours the ammonia water will have dissolved all that it can of the carbonate, and it will be of a deep-blue color. Unlike the Bordeaux mixture, this is a perfectly clear solution, and will not clog the finest nozzle. It must be diluted before use with twenty times its volume of water.

One more liquid fungicide is deserving of mention, — a solution of one pound of potassium sulphide in forty-five gallons of water. This is a cheap fungicide, and in some cases moderately effective. The Bordeaux mixture, however, presents certain advantages over any other fungicide. The excess of lime which it contains renders it very adhesive, so that a heavy rain is necessary to wash it off from the foliage, and usually three treatments only are required during the season. Furthermore, the presence of lime allows of the addition of arsenical insecticides, such as Paris green or London purple; the arsenite retains its insoluble form, and no burning of the leaves results, while its action as an insecticide is unimpaired, and we have a cheap and effective combined fungicide and insecticide. This is not true of any solution containing ammonia. If the arsenite be added to such a solution, it is rendered soluble by the ammonia, and extensive damage to the leaves is sure to result from its application.

Lastly, the Bordeaux mixture presents one very peculiar property. It has been repeatedly proved that, if the mixture be applied to potatoes, for example, the latter experience a benefit over and above that caused by the prevention of the "mildew" or "rot." Even when no disease is present, the

vigor of sprayed vines is greater than that of adjacent vines which have received no treatment, all the other conditions being the same for both. Whether this distinctly beneficial action of the Bordeaux mixture is due to a decrease in the rate of transpiration of water from the leaves, caused by the presence of the copper salt, or whether the land plaster, into which the lime of the mixture is in a great measure changed, acts as a fertilizer, is a question which has not yet been settled; but the fact remains as not the least of the advantages obtained by the use of Bordeaux mixture as a fungicide.

This concludes the list of most generally useful liquid fungicides. But one or two adapted to special purposes should be mentioned. One of these consists of eight ounces of formalin added to fifteen gallons of water, and is used as a wash for seed potatoes, to disinfect them from the germs of the scab fungus. Formalin is a powerful antiseptic, and it bids fair to supersede the solution of corrosive sublimate formerly recommended for the treatment of potatoes, as it is equally effective, and does not possess the extremely poisonous character of the sublimate.

Wherever cereals are raised in large quantities, the so-called Jensen hot-water treatment is becoming increasingly popular. It consists in immersing the seed-grain for five to ten minutes in water heated to 135° F. By this means the smut of wheat, oats and barley may be practically prevented. The pecuniary advantage derived from this simple process by the large grain-growers of the West during the past decade is incalculable. In Idaho alone, in 1893, one-fifth of the oat crop, valued at $120,000, was destroyed by smut. Later experience showed that fully 90 per cent of this loss might have been prevented by the simple expedient of subjecting the seed-oats to the action of hot water for a few minutes before sowing.

Among the many fungicides which are used as powders or vapors, sulphur, or mixtures the basis of which is sulphur, easily head the list. Even for out-door work, powdered sulphur is often an invaluable fungicide, as, for example, in treating the leaf-blight of celery, when no other fungicide seems to be quite as effective. Experience has taught us to apply the sulphur to the plants on a dry day, in full sunshine,

though it is difficult to say why the treatment is more effective under these conditions.

In greenhouse work sulphur vapor has long been an accepted fungicide. Mixed to a paint with oil, and applied to the heating pipes, it exercises a mild but constant preventive action upon fungous growth. If the latter is sudden and persistent, sulphur, or a mixture of linseed oil and sulphur, allowed to boil, without taking fire, in shallow iron dishes for five or ten minutes, will speedily rid the plants of all forms of "mildew." In the case of the "rusts," particularly of carnations, and of the various leaf diseases to which violets are so frequently subject, the bleaching action of sulphur renders its use inadvisable, nor in such cases does it seem to have much effect. The destruction of the parts affected, thorough drainage, and the use of some liquid fungicide, will give decidedly better results.

Now a word as to the means of applying fungicides. For the application of fine, dry powders, nothing is better than the "powder gun," or some similar device for blowing the powder upon the plants. Sulphur, however, easily clogs such an apparatus, and is best applied by hand. In the case of liquids, it is almost needless to say that the old-fashioned methods of the watering-pot, rose nozzle, or whisk broom are inadequate. In order to insure the highest degree of efficiency, together with the least expenditure of labor, time and money, some form of apparatus must be used which will deliver a fine, mist-like spray, capable of just moistening, without drenching, every part of the plant to be treated, and which will develop sufficient force to carry the spray to a distance of at least ten feet from the nozzle. These two objects are attained by the use of some special form of nozzle which will break up the stream, and by the use of a force pump mounted in various ways according to the special work which it is required to do.

Among the many patterns of spraying nozzles now on the market, perhaps the most generally useful is the Vermorel, which delivers a copious, mist-like spray of a conical form, with a wide spread and good carrying power. Attached to a long hose carried on a pole, or better still, attached to the end of a long, hollow bamboo rod connected with the hose,

it is an easy matter with this nozzle to deliver the spray into the tops of the highest orchard-trees. For such work the double Vermorel nozzle, so adjusted that the adjacent sides of the two conical sprays will be parallel, is the best device with which I am acquainted. The single nozzle sells for $0.50; the double, for $1. An eight-foot, brass-lined bamboo pole to carry the nozzle can be bought for $2.

In order to maintain a constant stream and to deliver it with sufficient power, a force pump is essential. These are now made in many patterns by almost all manufacturers of pumps. In my own work I have found that, when spraying is to be done on a small scale, as in the greenhouse, a vineyard or potato field of an acre or less, and in gardens, some form of knapsack sprayer, to be carried on the back and shoulders, is serviceable. It consists of a copper tank holding four or five gallons, and fitted with a small force pump worked by a handle, which hangs over the shoulder of the operator. The catalogue price of such an outfit, with hose and nozzle complete, is about $12. A still simpler and cheaper device, which I have used even in orchard work on a limited scale, consists of a small pump, costing $7, which is made to clamp firmly to the side of the pail. By making use of a forty-pound candy pail, I have found such an outfit fully as convenient as the knapsack sprayer. For work on a larger scale, as in orchards, extensive vineyards or potato-fields of two acres and upwards, a large receptacle and force pump are essential. In its usual form such an outfit consists of a fifty-gallon cask (a kerosene barrel, for example), mounted on a low wagon and fitted with a force pump of considerable power, made for the purpose. Such a pump is usually provided with a double outlet and two lines of hose, so that two rows of trees can be sprayed simultaneously. The essential points to be noted in a spraying pump are: (1) a good-sized air chamber, sufficient to maintain a steady spray for at least a minute, without pumping; (2) all the working parts to be made of brass, as Bordeaux mixture corrodes iron; (3) the valves to be of brass; (4) a low head, so that the outfit may be driven underneath fairly low-hanging branches; (5) an automatic agitator, to keep the mixture thoroughly stirred. Pumps

embodying these features can be bought for $10, and $2 or $3 extra will purchase the necessary hose, nozzles and bamboo extensions.

Within the past few years a number of expensive mechanical spraying outfits have made their appearance on the market; but they do no better work than the simpler ones just described, and are not as well adapted to general farm and orchard use.

A special adaptation of the barrel pump for spraying potatoes was devised a few years ago by one of our Connecticut farmers, and has proved extremely satisfactory. The pump is mounted in a barrel on a cart, as usual, but, instead of being provided with two outlets, it has but one, which connects with a half-inch hose. This projects over the tailboard of the cart, and carries the mixture to a piece of gas pipe nine feet long, fitted with Vermorel nozzles three feet apart. The pipe is carried, at right angles to the wagon, by a man walking behind, or it may be fastened to the rear of the wagon itself. By means of this device four rows are sprayed simultaneously, and two men can easily spray ten acres of potatoes in a day.

But, after all, does it pay? This is the only practical question in the whole matter. We may take for granted that fungicides are effective in preventing fungous diseases; but will the quality of our apples, potatoes, etc., be enough improved by spraying to make of that operation anything more than a harmless fad for rich men and a means of employment for scientific theorists? These are days of high wages, keen competition and low profits. Can the average farmer, with, say, fifty apple and other fruit trees, an acre of vines, two or three acres of small fruits and the same of potatoes, spend money on a spraying outfit, with any hope of finding himself richer rather than poorer at the close of the season? To this question I should reply emphatically in the negative, if that farmer thinks that he can starve his trees, leave his land untilled and disregard every rule of orchard sanitation, and then expect a little Bordeaux mixture, carelessly prepared and applied at hap-hazard, to make good all his omissions and give him a sound and abundant crop. But, given an orchard which receives intelligent and proper care in the way of culture, spraying becomes a most valuable

adjunct in increasing profits. The two must go hand in hand, if the best results are to be attained. The up-to-date farmer cannot afford to take any chances.

Let us look at a few figures representing the results of the practical use of fungicides. A few years ago a circular letter was sent out to the vineyardists of New York, asking for information regarding the prevalence of black rot and the value of spraying. Replies were received from 250 growers of grapes. They reported a yield of perfect fruit amounting to 37,000 pounds, valued at $13,000, as the net profit in one season from the use of Bordeaux mixture. The average cost per vine, for four treatments, was stated to be three cents. One grower reported that, of two acres of vines, one sprayed six times and the other not sprayed, the former gave a yield of 1,750 pounds, valued at $52.50; the unsprayed acre yielded 500 pounds, valued at $15. The total expense of spraying one acre six times, exclusive of the initial cost of the outfit, was $7.25, leaving a net profit of $30.15 per acre as the result of spraying.

The Vermont Experiment Station has for some years conducted experiments in spraying potatoes on a commercial scale, with great though not unusual success. Their results are of special value, from the fact that the work was very carefully done, every item of expense was noted, and the profits were figured out by comparing the yields from two large areas identical in every respect, except that one was sprayed and the other was not. One acre, sprayed three times with strong Bordeaux mixture, yielded 223 bushels of sound potatoes; an adjacent acre, not sprayed, yielded 110 bushels; gain in favor of the sprayed acre, 113 bushels, or 103 per cent. At 80 cents per bushel, the gross profit per acre amounted to $90.40. The cost of spraying one acre three times was $4.35, divided as follows: —

Thirty-six pounds of copper sulphate, at 5 cents,	$1 80
One barrel of lime,	1 65
Labor, two men at $1.50 per day,	90
Total,	$4 35

On this basis the net gain from spraying amounts to $86.05 per acre, exclusive of the cost of the outfit.

It costs proportionately less to spray ten acres than one acre, owing to the fact that it pays to buy lime by the barrel, and one barrel will serve for much more than ten acres. Taking the Vermont results from one acre as a basis, the gross profit on ten acres, at 70 cents per bushel, would be $791. The cost of spraying, including the necessary outfit, would be about $44, leaving a net profit of $747.

A year or two ago I compiled, from various authentic sources, the possible profits from the spraying of an apple orchard. The orchard was supposed to contain 200 trees, of which 190 were sprayed and the remainder left untreated, as a check. From the results of actual experiments the yield of fruit from the ten unsprayed trees was calculated as follows: —

First quality, 20 bushels, at $2.25 per barrel, ...	$16 80
Second quality, 22 bushels, at $1.75 per barrel, ...	14 40
Third quality, 24 bushels, at $0.10 per barrel, ...	90
Total, ...	$32 10

Ten of the sprayed trees gave the following yield: —

First quality, 110 bushels, at $2.25 per barrel, ...	$79 80
Second quality, 20 bushels, at $1.75 per barrel, ...	12 60
Third quality, 5 bushels, at $0.10 per barrel, ...	20
Total, ...	$92 60

On this basis the value of the crop from 190 sprayed trees would be $1,759.40; from a like number of unsprayed trees, $609.90; leaving a balance of $1,149.50 in favor of the sprayed trees.

Now as to the cost. I allowed in this case for the cost of the outfit; for the cleaning up of the orchard in the spring; for one winter treatment with the simple solution of copper sulphate, one pound to twenty-five gallons of water; for one early spraying with strong Bordeaux mixture, containing five pounds each of copper sulphate and lime to fifty gallons of water; for three subsequent treatments with the same mixture, to which Paris green was added at the rate of one-half pound to each barrel; and, finally, for one late treatment with half-strength Bordeaux. The items are as follows for 190 trees: —

Outfit, complete,	$16 40
Labor in cleaning up orchard, one man for two days,	3 00
One winter treatment (copper sulphate),	5 50
One early treatment (strong Bordeaux),	9 29
Three summer treatments ($10.47, $12.48, $14.99) (strong Bordeaux and Paris green),	37 94
One late treatment (half-strength Bordeaux),	9 75
Total cost, 190 trees,	$81 88
Cost per tree, including outfit,	$0 43
Cost per tree, not including outfit,	35

Subtracting this total cost from the gross profits leaves a net profit from 190 sprayed trees of $1,067.62, or $5.61 per tree, over those not sprayed. It is furthermore interesting to note the individual differences between sprayed and unsprayed fruit. According to observations made at the Cornell Experiment Station, one bushel of King apples from a sprayed tree contained 202 apples, averaging 4 ounces in weight. A bushel from an unsprayed tree of the same variety contained 317 apples, averaging 2½ ounces in weight. The sprayed fruit, then, shows a very marked increase in size and weight over the unsprayed, owing to the healthy foliage of the sprayed tree.

As to the keeping quality of sprayed apples, — a most important factor, — an experiment of my own is striking. Three years ago, I stored two barrels of the same variety of carefully selected apples, one from a sprayed tree, the other from one not sprayed, in a cool, dry cellar. On November 1 the unsprayed apples showed signs of shrivelling and decay, while the sprayed fruit was as firm and plump as at first. By January 1 the unsprayed apples were completely ruined; the others were still sound, and remained so until February.

If it be true that "figures cannot lie," those which I have given present strong testimony in favor of spraying. I do not, however, wish to give the impression that such large profits will accrue every year, or even in the long run. An exceptionally favorable location, a high state of cultivation, judicious pruning, the selection of resistant varieties, — these and other factors all unite to diminish the profits

directly attributable to spraying. Different seasons, also, show great variation in the prevalence of fungous diseases, a dry season reducing them to a minimum. I can readily imagine circumstances under which the profits accruing from spraying in a single year would hardly cover the expense; but there is no question whatever that the man who sprays his fruit-trees or his potatoes thoroughly, persistently and intelligently, will, other things being equal, realize profits far in excess of the man who neglects spraying, or practises it spasmodically and without any intelligent plan.

The truth of this statement is not always apparent, simply because the average farmer neglects what seems to an outsider a feature of primary importance in farm economics. In every other successful line of business, except farming, the operator knows what he is about. He knows what returns he is getting on every branch of his investment, and once a year at least he prepares a balance sheet of receipts and expenditures. The farmer usually does nothing of the kind. A supposed improvement in methods is adopted by him, if adopted at all, on hearsay. He does not, and the chances are he never will, know whether that practice really nets him a profit or not. It appears, when adopted, to be an advantage, but he may be deceived by appearances. He may go on for years actually losing money, when all the while he is congratulating himself on the supposed fact that he is thoroughly "up to date," and therefore necessarily prosperous. As a matter of fact, no practice is of certain value unless approved in every instance by the balance sheet.

I have told you, for example, that it pays to spray potatoes; now, the last thing you should do is to believe my word without further proof. You know nothing of me personally. I may be mistaken in this matter, or, for anything you know to the contrary, I may be in the pay of some pump-manufacturer. Or it may be that results obtained in Vermont cannot be duplicated in Massachusetts. What, then, are you to do? The only proper proceeding is, in case you have any confidence in my statements and in the experience of others, to test the matter for yourselves, and to test it intelligently. Buy or borrow a pump, and spray your

potatoes, — not all of them, of course, for in that case you will know no more regarding the efficacy of spraying at the close of the season than at its beginning. You must have a basis of comparison, and that basis must be a portion of your own field which you leave unsprayed. Make the test a thorough one, even if it costs a little more to do so; note carefully every item of expense connected with the experiment; compare the product; note the exact comparative yield; keep a record of the cash received for every peck of potatoes from that field. To the keeping of such an account spraying lends itself more easily and accurately than any other farm operation; and within three months after the close of the season you will know to a dollar the net result of spraying potatoes on your land and in that particular season; and you will have learned in one year more than any human being could teach you in ten.

With this advice I must close, only urging you, in conclusion, to bear in mind the main features of what I have told you regarding the fungous diseases of plants: that they are not mysterious agents of destruction, with no attributable origin, but are plants of definite and known habits, which prey upon their higher relatives; that, like weeds, they propagate and spread if not destroyed; that by cleanliness and care the damage which they do can be lessened; and, finally, that by the intelligent use of fungicides they can in many cases be practically controlled, to the great advantage of the farmers' pocket-book. Accept with hesitation the suggestions of others, but, if they commend themselves to your own judgment, test them for yourselves, and spare no pains to make the test a conclusive one from a business stand-point.

Mr. B. P. Ware (of Marblehead). We have had one of the most instructive and practical lectures on this subject that I have ever listened to. I would like to draw attention to the wonderful intelligence that appears from that little black spot, the onion smut. I have unfortunately had a good deal of experience with onion smut, and can testify that these spores will remain year after year in the soil, and when onions are grown again they will appear.

Now, it seems to me that that little black spot, that will lie in the ground year after year, let any crop of other vegetables be grown, manifests very much intelligence, and knows that that year the farmer has planted onions where before he has planted turnips and potatoes and carrots. This black smut has taken no notice of the other crops, but all at once it appears, and the question arises, whence that intelligence.

Dr. Sturgis. I should hardly call it a matter of intelligence. It merely grows where it can. As the little seedling onion bursts out from the seed and begins to push up through the soil, the spores come in contact with it and germinate, simply because it is the soil it needs for germination. The very contact with the onion tip is sufficient to stimulate that onion smut spore into growth. It is not intelligence, it is a matter of environment. It is bringing together two organisms that can grow together.

There is one way of getting around the onion smut spore. It will only attack the onion seedling tip. Get the tip of the onion above ground and it will grow in a bed of spores. It is only through the delicate tip of the seedling that the onion smut gets into the plant at all. If you can start the seedlings in a greenhouse and transplant them to the field, you will never see a sign of the smut. I have experimented, as a means of demonstration to the onion growers of Connecticut, on the comparative results of planting onions by seeds and seedlings. With transplanting you get rid of thinning, the first weeding, and the smut, and, instead of having them of a small size and crowded in the rows, you get big onions and get them three weeks earlier. The Connecticut farmers laughed at me when I said they could get onions three weeks earlier, with bigger bulbs and free from smut.

Mr. Ware. I am very thankful that my remark has brought out so much additional information. The smut attacks the seed when first sprouted, as I understand it.

Dr. Sturgis. Yes. It is only through the extremely delicate tip of the onion that the spores can gain entrance.

Mr. A. M. Lyman (of Montague). What causes the colored spots in the apples?

Dr. Sturgis. I suppose you refer to the little brown

specks. No one knows the cause. It is not a fungous disease. Spraying has no value in checking it. It is supposed to be due to the thinness of the skin of certain varieties of apples, whereby in a dry season the water is given off from the interior of the fruit. We always find these little brown specks with perfectly sound flesh all around them.

Mr. LYMAN. Are the black knots of the plum and cherry identical?

Dr. STURGIS. Yes, sir.

QUESTION. Is there such a thing as canker of the cherry?

Dr. STURGIS. It depends on what you mean by canker. A great many things have been given the name of canker. I have seen it caused by the woolly aphis. There are diseases of the apple, pear and quince where canker is caused by fungus. I never happened to see it on cherry or plum.

Prof. WM. P. BROOKS (of Amherst). It occurs to me that we need a little more light on the question of the intelligence of the spores. I wish the speaker would make it clear whether it is not a fact that if one of those spores got into the right position in the soil it will, whether onions are planted there or not, germinate. But of course it is not able to carry itself over into another year because it does not find the proper plant to go through its different stages.

Dr. STURGIS. If the spore germinates without finding the proper plant, undoubtedly it perishes.

Professor BROOKS. It will germinate, will it not, provided it gets into the right position in the soil?

Dr. STURGIS. I hardly think it probable that it could.

Professor BROOKS. Certainly, if the onion spores are buried too deep to germinate, it will take many years before all of them will be brought into the right position in the soil, which I judge must be near the surface.

Dr. STURGIS. It is a matter of supposition. I think burying it deep would kill it, if anything would. That would be the natural course with most fungous spores. I do not know that experiments have been made on the germination of the spores in the soil.

Professor BROOKS. I did not question the speaker's knowledge of this matter. The spore is to be looked upon as similar to the weed seed. If a weed seed happens to get

in the right position in the soil, sufficiently near the surface to get air, moisture and warmth, it will grow. If buried too deep, it will not grow. I had supposed that these spores were similar, and that slowly the resting spores of the onion would lose their capacity to injure later onion crops. They would not all lose this capacity the first year, some the first year and some later. I would like the speaker to give the audience his opinion.

Dr. STURGIS. It is a perfectly impossible question to answer, simply because there are no experiments, so far as I know, to show whether an onion spore will germinate apart from the presence of an onion plant. Land may lie fallow or be plowed successively for different crops year after year for six, seven or ten years, and yet reproduce onion smut the eleventh year in as large a degree as it did the first year. This would indicate that the process of destruction must at any rate be an extremely slow one, and one which we certainly cannot count upon for practical results.

Professor BROOKS. Is it not easy to understand that that might be the case, when we consider the enormous number of these spores? We know it takes a great many years to get rid of a weed, and we must remember that the number of weed seeds as compared to the number of spores is small.

Mr. GEO. P. SMITH (of Sunderland). What is the nature of the spore that causes the blight of the onion?

Dr. STURGIS. There is a regular mildew of the onion, something like the mildew of potatoes. There is also another trouble, which looks something like mildew, that is caused by a very minute insect of the genus thrips. There are a number of fungous diseases, and it is hard to tell what one is meant by the term "blight." If I could know the appearance of the diseased plant, I might be able to say more about it.

Mr. S. R. MAYNARD (of Berlin). How many gallons of Bordeaux mixture are required to spray an acre of potatoes if the tops are well grown?

Dr. STURGIS. I cannot answer from memory. I should say that between sixty and seventy gallons of Bordeaux mixture would spray an acre of potatoes pretty well.

The CHAIRMAN. Perhaps Mr. Kirkland could give us some information in this line.

Mr. A. H. Kirkland (of Melrose). I had the good fortune this summer to make three trips into the Aroostook region, Maine, where the most enterprising potato growers make a business of spraying their potatoes. They use the Aspinwall sprayer, with four nozzles. They calculate that something like twenty-five gallons to the acre is sufficient for the first spraying, when the potato tops are just noticed. A fifty-gallon cask is sufficient for two acres. When the tops are full grown they try to put on fifty gallons to the acre, but do not always get it all on. They find the use of Bordeaux is a very practical matter. I was in Aroostook about two weeks ago, and was talking with a farmer who had 47 acres of potatoes; 33 acres were in one piece. He sprayed his whole field of potatoes with Bordeaux mixture. He had 13,365 bushels of potatoes, or about 280 bushels to the acre. The near-by fields this year yielded only two-thirds of that crop. There are dollars and cents in this matter of spraying.

Mr. J. L. Ellsworth (of Worcester). Did they spray more than once?

Mr. Kirkland. The best growers sprayed three and some four times. They began when the tops were about six inches high, and kept it up until the vines were so rank they could not drive between the rows. Their potato crop is their main dependence, and they find it best to apply the Bordeaux mixture every week or ten days.

Question. How much Paris green should be used?

Mr. Kirkland. Some use as much as two pounds to fifty gallons. These goods are probably adulterated. One-half pound to fifty gallons should be sufficient.

Dr. Thompson (of Worcester). I have grown fruit in New York State, and have been deeply interested in the lecture. While I am not a fruit grower at present, I am deeply concerned in everything that helps the farmer. While in New York I was much interested in spraying. I have seen the failures that they have met with, and also the successes; and I have been interested in the improvement that is noticed on land sprayed over that not sprayed, and in the large profits reaped from the crops sprayed over those not sprayed. They have had to spray in New York more than you have here. You have more woodland and more birds than we have in

New York State. New York State is largely occupied with fruit growing. Spraying has become a matter of real profit with them. Hull Brothers of Gosport, N. Y., make the best pump. The nozzle the lecturer mentioned is, no doubt, a good one. My experience was that the Niagara and the Dewey nozzles were the best. The pump having two cylinders is not liable to wear out as soon as those with one cylinder. I saw this used with two, three and four nozzles, and it thoroughly filled the air with a fine spray. The Friends are running their factory night and day, and still find it hard to fill orders. If you will write them and mention Dr. Thompson, they will use you right. I have distributed some of their circulars. I am not an agent, I am a clergyman; but as I am interested in the farmers and in fruit growing, I thought it a wise thing to present this this morning.

AUSTIN HEYWOOD (of Worcester). Fungus has attacked the muskmelon and the cucumber this year. Do you use Bordeaux mixture for that?

Dr. STURGIS. Yes, but not with great success. We have been investigating this for five years, with practically no success. I am inclined to think it is in the constitution of the vine more than it is in the spraying. I am beginning to think that we can feed our plants. Instead of giving them the whole of the fertilizer at once, give them half the amount at first, and the other half sown broadcast before the vines begin to run. Give them two or three meals instead of one, and I think we will have more vigorous plants. I am very much taken with the experiments with lime on melon plants, — the extraordinary benefits coming from liming the soil before attempting to grow melons.

Mr. BOYLSTON. We have discarded Paris green, and used a powder called "Bug death." Certainly with potatoes we get a great deal better results. In two or three hours' time the slug is dead and disappears from the potato vines. They claim also that this "Bug death" acts on the fungus and destroys it. I would ask the doctor if he is at all acquainted with it and the results?

Dr. STURGIS. No, I never have experimented with that at all. As a rule, at the experiment station we have to stick

close to recognized things. Some of the stations make a business of analyzing a good many things put on the market. Cornell has done a great deal of it. We have done very little except with Paris green. Every year there are things sent to us that will cure all diseases of plants. We have not the time or money to give them the test that they ought to have, to decide if they are of value. After all, the farmer must test these things for himself. He must have a little experiment station on his own farm.

QUESTION. What is the cause of the Sheldon pear cracking when about half grown, and turning dark colored?

Dr. STURGIS. It is a fungus very nearly related to the apple scab. It can be controlled in the same way by spraying. I know of no other way.

Mr. C. H. PARKER (of Holden). I want to express my satisfaction with the lecture. I think it about time for the farmers, even if they grow a small acreage of potatoes, to adopt some of these methods. I heard it said that the progressive farmer sprayed his potatoes. Now, there are a good many in my town who are not progressive, that I really supposed were fairly up in the line of progress. I had five acres this last year, and the crop was an absolute failure, for the blight struck the potatoes before they were half grown, and it hardly paid to dig them. I shall either spray my potatoes in the future, or cease to plant them.

The CHAIRMAN. The time has been fully occupied, and we will have to postpone Professor Maynard's talk on apples until after the afternoon lecture.

Adjourned to 2 o'clock.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock by Second Vice-President Pratt, who said: We have for our consideration this afternoon a very important subject, — the subject of ventilation. The lecturer is a graduate of the Massachusetts Agricultural College and the professor of veterinary science at that institution, and is thoroughly acquainted with his subject. I take pleasure in introducing Dr. Paige, who will speak on "Stable ventilation."

STABLE VENTILATION.*

BY JAMES B. PAIGE, D.V.S., VETERINARIAN TO THE BOARD.

I know of no agricultural topic upon which there is as great a diversity of opinions as upon the subject of the lecture at this session.

Every farmer, large or small, educated or uneducated, rich or poor, seems, in this matter of stable construction and ventilation, to be a "law unto himself." From the brains of the farmers there have been evolved plans of stables and systems of ventilation without number; and, strange as it may seem, there are no two alike, with the exception of the old-style New England stable; and each has been equipped with a ventilating system peculiar to itself, except that in the old stable no especial provision was made for ventilation.

If we take the more modern stables of the better class, those, for instance, that have been erected on our best stock farms during the past decade, we find that this same wide variation respecting general arrangement and provisions for ventilation exists. This wide variation must have been a necessity to a greater or less extent, so far as general plans were concerned.

The style of architecture and arrangement of each have been largely influenced by the contour of the surface of the site, position of other buildings, special purpose for which it was intended, etc.

If there is this great difference in architecture and plans to be found, there is still a greater difference to be noted in the systems of ventilation that have been introduced into them. In no two are the systems alike in every particular, and in many of them we find the arrangement entirely different in principle and detail. In some instances there are ventilators

* Abstract of paper, illustrated by stereopticon.

arranged to take the foul air from the bottom of the stable; in equally good stables it is arranged for it to escape from the top. In some, fresh air enters near the floor; in others, near the ceiling. Some builders provide separate openings for the admission of fresh air and the escape of the foul; while others, still, provide at great expense shafts, ducts and cupolas, that shall serve as both inlets and outlets.

The arrangement of the inlets and outlets is frequently such that it is by no means possible for them to serve the purpose for which they have been intended.

In some of the more modern barns, in the construction of which large sums of money have been expended, there exist the worst of sanitary conditions, — even worse than in the old-style stable of fifty years ago. In the latter no attempts were made to secure good sanitary conditions, no thought was given to supplying fresh air for the occupants of the stable. Every effort was directed toward keeping the stable warm by excluding the outside air. In spite of all these efforts, the animals received a liberal supply of fresh air through openings in the walls. At that date matched boards were difficult to secure, hand-shaved clapboards were too expensive for use upon stables, and rosin-sized sheathing paper had not been thought of. Open barn cellars at that time were the rule and not the exception. The inevitable results of such a form of construction were a cold, airy, uncomfortable barn; but animals kept in such buildings were tough and hardy, with strong disease-resisting constitutions.

With the advent of greater demands and higher prices for dairy products it became apparent to the dairyman that he could increase the products by keeping the animals warm. Practical experience soon taught that a cold stable and a full milk pail were incompatible elements. The agricultural press and agriculturists have for the past twenty-five years been instructing the farmer that to secure the greatest return from his animals it was necessary that they be kept warm.

The results of this teaching are to be observed to-day in the old as well as in the modern stable. In the former the cellars have been closed, the cracks in the walls have been battened over, and so far as possible every opening through which fresh air could get in has been tightly closed; in

addition, the manger fronts have been closed in with shutters. In the modern stable, in place of the wall of single thickness of straight-edged boarding we find one of matched boards, sheathing paper, clapboards, and with inside walls sheathed or plastered, — a condition quite in contrast to that found in the old stable, so commonly seen in some of our remote rural districts. I would not have you think that the modern stables possess no advantages over the old-style one. There can be no possible objections to keeping animals in a warm barn, provided they are supplied with the essentials of good health, such as fresh air, sunlight, wholesome food and water.

It is possible, in a stable with walls constructed of several thicknesses of board, sheathing paper and plaster, to regulate conditions of temperature, distribution of air currents, etc., to a much greater extent than in one with only a single wall. The trouble in the past has been that in using sheathing paper, clapboards and plaster to make the stable warm no provision has been made for the introduction of fresh air, which in the old-style stable sifted in through the cracks. In general, the sanitary condition about our stables has been very bad.

In many instances an attempt to improve them has resulted in converting them into hotbeds for the propagation of disease. Our experience during the past five years with bovine tuberculosis has shown that the disease is most prevalent in those herds kept in our so-called "best barns." This is not wholly due to influence of stabling, but to a forced system of feeding, lack of exercise, close in-and-in breeding, the most potent predisposing factor being defective ventilation. Good sanitation, together with a rational system of feeding, breeding, etc., favor the development of strong constitutions in animals, which is the one quality above all others that affords the greatest protection against disease.

Experience has taught and statistics prove that infectious diseases are more prevalent, spread more rapidly and are more fatal among animals kept under unsanitary conditions, in damp, poorly lighted, badly drained and unventilated stables, than among those surrounded by hygienic influences. Parkes says, "Disease and health are in the direct propor-

tion of foul and pure air." Our work in Massachusetts during the past ten years in the suppression of tuberculosis among cattle has shown that the prevalence of the disease in a herd bears a close relation to the hygienic conditions under which the animals are kept. The more defective the sanitation, the greater the prevalence of the disease. It has also been observed that the spread of the disease is much more rapid and the course of it more acute among cattle under unsanitary conditions. The arrest of the disease in animals and its transmission to others can be better controlled by sanitation than by the administration of drugs. Animals showing marked symptoms of the disease, such as emaciation and general unthriftiness, are frequently so much benefited by an improvement in the sanitary conditions about them, or being allowed to run in pasture, that it is quite difficult to detect the disease in them by physical examination; and it is quite generally believed among veterinarians that the disease in its early stages of development may be completely arrested by this method of treatment.

Glanders among horses furnishes us with another striking example of the relation of poor sanitation to the spread and development of a disease.

In the early part of the present century the yearly loss of horses in the French army from this one disease amounted to 2.3 per cent. By an improvement of the sanitary condition about the stables, increasing the cubic capacity and providing a larger supply of fresh air, the deaths from this cause were reduced to .7 per cent.

It is a well-known fact that horses may suffer from glanders in a chronic form for months, without showing marked symptoms of the disease or without a rapid development of it, provided they are subject to hygienic influences. On the contrary, the disease develops rapidly and assumes an acute character when such animals are removed to damp, dark, ill-ventilated stables. Wounds that under ordinary circumstances would prove trivial, frequently become gangrenous and prove fatal under similar conditions.

The same relation exists between unsanitary surroundings and the cause and spread of diseases among other domestic animals as has been shown to exist in tuberculosis in cattle

and glanders in horses. Hog cholera, swine plague in pigs, distemper in dogs and catarrhal inflammation in poultry are familiar examples.

Malnutrition, enervation, emaciation and inflammation of the mucous membrane of the respiratory tract, are some of the general effects to be observed of the action of impure air. Its tendency is to depress the vital functions and to weaken the natural resistant forces of the body by which disease is prevented.

Properly, the subject of stable ventilation ought to be considered together with other subjects of veterinary hygiene, such as stable construction, including construction of floors, stable drainage, the removal of excrement, stable fixtures, lighting, etc.

Smith, in his treatise on "Veterinary Hygiene," says: "The objects of ventilation are the supply of pure air to the lungs, the removal from the stable of the products of respiration and cutaneous exhalations and the effluvia arising from the fluid and solid excreta deposited in it."

Ventilation is produced, says Billings, "By the movement of air, and such movement is due to some force, either derived from what may be called the natural conditions of the locality, or specially developed and applied for the purpose of producing currents."

We recognize two great systems of ventilation, namely, *artificial* and *natural*. In artificial ventilation, some other than natural forces are usually employed to move the air. This system is frequently referred to as a forced ventilation, from the fact that the ventilation is effected by the use of artificially heated chimney flues, by the use of blowers driven by machinery, etc. This system has no practical application in ordinary stable ventilation, owing to the expense of operation. In the natural system of ventilation we depend upon natural physical forces to rid the stable of impure air and to bring in fresh air to take its place. The forces that act are three in number: —

1. The difference in weight of masses of air of unequal temperatures.
2. The law of diffusion of gases.
3. The force of the wind.

The first of these forces is the chief one of the artificial system of ventilation, where heated air is used in flues to remove the foul air, and to bring in pure air to take its place. Its action is based upon the fact that heated air is more rarefied and lighter than cold air, and therefore has a tendency to rise above it. In artificial systems of ventilation, heaters, radiators, steam coils, etc., are placed at the bottom of flues, which have openings into the rooms which are to be ventilated, to create an upward and outward current of heated air, which draws the foul air out, while the pure air is introduced into the room through some other opening.

In natural ventilation, as in the ventilation of stables where artificial heat is not used, we get considerable benefit from the action of this force, the heat being derived from the bodies of the animals. It is the force that takes the expired air from the animal. It causes upward currents in the centre of the building, and, if there are suitable openings above and below, the vitiated air escapes. In case no openings exist above, the air cools from contact with the ceilings and walls and again settles to the floor. The currents which arise from this cause also assist in keeping the air in a tightly closed stable or occupied room thoroughly mixed and of even quality. Without suitable inlets for the admission of pure air, or outlets for the escape of the foul air, this force can do but little more than keep the air in a well-mixed condition. The beneficial effects of this force are frequently lost on account of the outlets being so far above the floor. When such is the case, the warm air leaving the body of the animal becomes cooled to such an extent that it becomes heavier than the air below, consequently tends to fall, displacing that below.

In high, old-style stables, used for both storage and stabling purposes, with high beams above the main floor and a single large cupola opening in the roof, it frequently happens, in cold weather, that little or no foul air escapes through the cupola opening, owing to the fact that the upper portion of the building is filled with air that has become so much cooled from contact with the exposed roof and walls that the temperature of the rising warm current is lowered to such an

extent when it comes in contact with it that it no longer continues to rise, but again falls to the floor. The cooled air in the upper part of the building acts as a cushion, against which the rising current strikes.

The second force of natural ventilation is that of the diffusion of gases. This force acts upon gases overcoming the force of gravitation. The heavier gas rises, the lighter descends. In stable ventilation this force acts to prevent the heavier gases from displacing the lighter ones. Otherwise, the heavier gases would form in layers above the floor in order of their specific gravities. The heavy, poisonous carbon dioxide (CO_2), exhaled from the lungs, would, in a close, tight-walled stable, continue to collect upon the floor, until the animals might become completely surrounded by it. We might have the same condition in our stables as is frequently seen in deep wells or mines, — a collection of CO_2 to such an extent that death results when a person descends into them, unless the gas has been previously forced out by means of fans, as in mine ventilation, or by means of a bundle of burning straw which is let down into the well to create an upward current and produce sufficient circulation to remove the carbon dioxide.

The tendency of gases to diffuse is so great that they will readily pass through walls of brick or wood that have not been rendered impervious by the application of paint or paper. When a wall is constructed of a single thickness of straight-edged or matched boards, air will readily diffuse through the cracks and crevices; but when sheathing paper and clapboards, particularly the former, are used over rough boarding, the process of diffusion is arrested.

The great advantage of the modern method of construction over the old is that we have conditions which are more under our control. The quantity of air brought in and removed can be varied to suit conditions of the weather and temperature outside.

The most important force of the natural system of ventilation to be considered is that of the wind. It is a strong ventilating agent, and the only one that need be taken into account in connection with mathematical calculations relative to the subject. Its irregularity of action constitutes its

greatest disadvantage. Our aim should be in the building of our barns to so construct them that this force may operate to the best advantage to remove the foul air and provide the occupants with fresh air. It is one of the fundamental principles which should always be taken into account in providing effective ventilation, that the air introduced into the stable shall be pure. Such cannot be the case when the air comes through the floor and scuttles, from a close cellar filled with manure, or from off a pile of decomposing excrement just beneath a wall scuttle in the rear of the animals (Fig. 1).

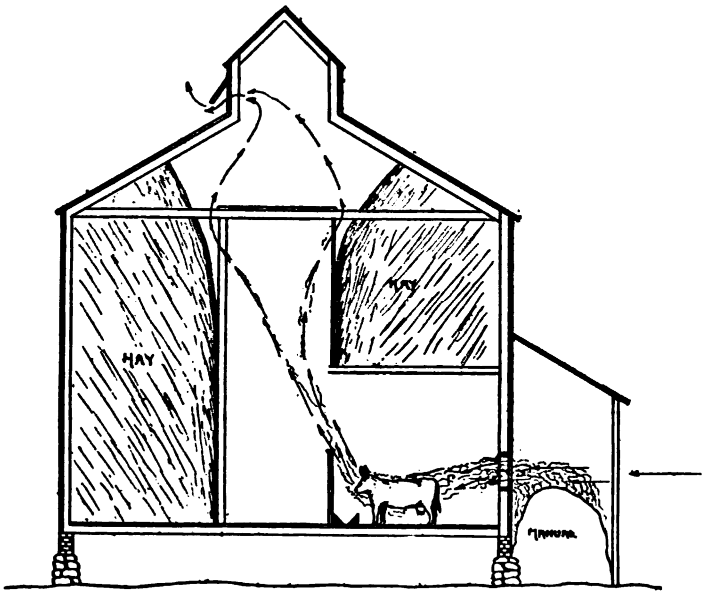

FIG. 1.—Section of stable, in which wall scuttles are used as inlet openings for the admission of air.

To satisfactorily light and ventilate our farm buildings, they must be properly located one to the other. The most desirable form of arrangement consists of a main part, for storage purposes, running east and west, with an ell for the animals, the latter connected with the main, running north and south (Fig. 8). This arrangement of the two parts of the stable at right angles provides a warm, well-protected yard, with a southern exposure. It is also advantageous in that the sunlight reaches every part of the stable, while the variation of the inside temperature between midday and

midnight is not nearly so great as in a stable running east and west. With a large number of windows on the east and west sides, and but few on the south end, in the early morning and the afternoon the sunlight streams through the windows in the sides, whereas little enters during the middle of the day, when the temperature of the stable is naturally highest.

Where stables run east and west, and the animals are arranged in two rows facing a central passageway, those animals upon the south side get the benefits of all the sunlight, while those on the north side get none.

In combination barns, used for storage and stable, where the cattle are kept under the scaffold, it is better, without question, to give them the southern exposure rather than the northern, for the objections to the wide range of temperature do not offset the stimulating effect derived from direct sunlight upon the animals, or the disinfecting action it has in the stable.

To secure effective ventilation in any building, two sets of openings are necessary, namely, inlets for the admission of pure air, and outlets for the escape of impure air. This applies to both systems of ventilation, but the relative position of inlets to outlets is not the same in both.

When the artificial system is employed, especially where heated air is the motive force, the inlets should be located in the walls near the ceilings, the outlets in the floor, on the same side of the room as the inlet.

In connection with this subject, I desire to call your attention to the experiments of Mr. Briggs of Connecticut, the results of which appeared in the report of the Connecticut State Board of Health a few years since. In natural ventilation, where cold air is brought in, the inlets should be in the walls near the floor line, the outlets in the ceilings, roofs or walls above.

In the storage of excrement about stables, every precaution should be taken to guard against contamination of the air of the stable or the air introduced into it to take the place of the foul air removed. Water-tight manure pits or sheds for the storage of excrement, situated at the end of the stable, are both convenient and sanitary.

The openings into the building should be provided with close-fitting doors. The solid excrement may be removed by means of a litter carrier or barrow, the liquid, carried in drains or gutters. If the manure is stored in sheds located upon the sides of the stable, and connected with it by means of wall scuttles, these must be tightly fitted and kept closed except when in use. They should never be opened for the

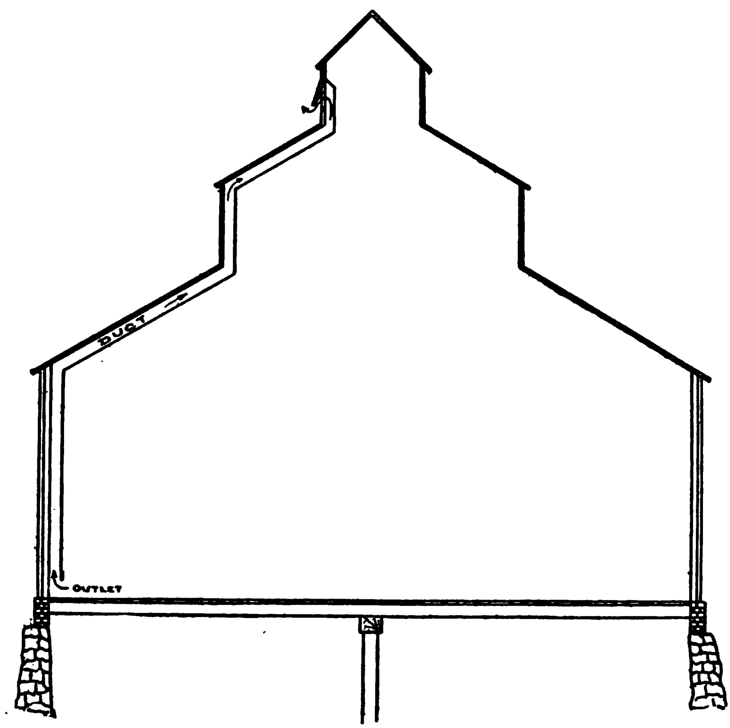

FIG. 2.—Cross-section, showing a ventilating shaft with too many angles.

admission of air, particularly when manure is piled below them outside.

Let us consider a few things in regard to the different forms of inlets and outlets which are frequently seen in use. The inlet and the outlet most commonly met with is the shaft or duct, usually constructed of wood in rural districts; in cities, of galvanized sheet-iron or tin. They may be of either material, round or square, located in the walls of the building or independently of them. In their construction

there are certain general rules that should always be observed. A round duct is preferable to a square one, as it has a greater carrying capacity, there being no dead corners. A smooth one is better than one that is rough, the velocity of the current, all other conditions the same, being greater in the former than in the latter.

To insure action, they should be as short and straight as it is possible to have them. Those of too great length are usually useless unless artificial heat be used in them to create a circulation of air. Those placed on the south side of a building, where they are exposed to the heat of the sun, are more efficient than those placed on the north side. The introduction of angles should be avoided as much as possible. Each right angle put in reduces the velocity of the current one-half (Fig. 2). When it becomes necessary, as it frequently is, to change the direction, a rounded elbow may be used to good advantage, it being claimed that it will not lessen the velocity of the current so much, there being no square angle for the air to strike against.

Every shaft or duct should be so constructed that it may be easily cleaned in every part. Neglect of this precaution often renders them useless. They soon become stopped with collections of cobwebs and dust (Fig. 3).

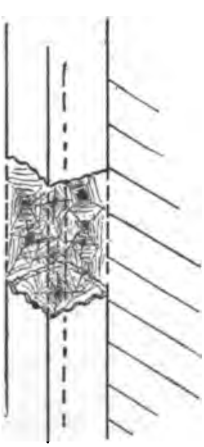

Fig. 3. – Section of duct, showing obstruction.

There are many ways of using tubes, either singly or in combinations, both as inlets and outlets. They may be placed under the floor, in the walls, or in the ceilings. Parallel vertical tubes opening on the ceiling above, leading to the outside through the roof or cupola, are a frequent form seen. One is supposed to act as an inlet, the other as an outlet. The action of this combination of tubes depends upon existing conditions.

If the building is occupied by a large number of animals, so that the temperature of the air inside is higher than that outside, all openings below closed, the walls of the ceilings not too high, the tube not too long, etc., then both tubes would act as outlets. If the reverse of these

conditions exist, the functions of the tubes would also be reversed.

To establish and maintain inward currents through one and outward currents through the other, it has been recommended not to build the dividing partition nearer than eighteen inches to the face of the ceiling. Others advise for the same purpose that a board set at an angle be put into the bottom of one tube and one into the top of the other, their position being such as to offer resistance to the circulation of a current of air in the opposite direction from what is desired.

To insure at all times the desired action of a shaft or tube, either as inlet or outlet, cowls are sometimes attached to the upper end. There are two varieties, the fixed and movable. The principles of action vary according to the pattern. Some are so constructed as to produce an upward circulation by the Archimedean screw principle, the motor force being a mechanism which is operated by the wind. In other varieties the force of the wind is so directed across the open end or side that air is either driven through the tube into the building or is aspirated out of it. So far as I have observed, none are absolutely positive in their action. The stationary variety has the advantage over the movable kind in that it is entirely automatic, acting with the wind in any direction, and is less liable to get out of order than any movable pattern (Fig. 4).

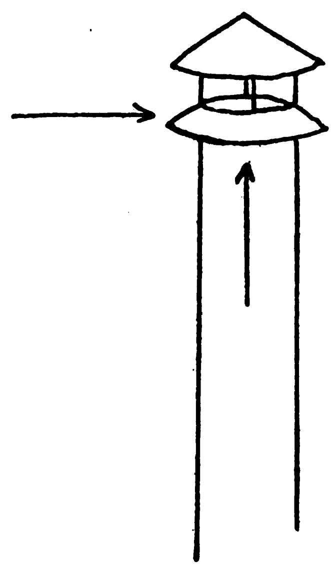

FIG. 4. — Stationary outlet cowl.

In stable ventilation draughts are best prevented, and the incoming currents best distributed, by having numerous small openings as inlets and outlets, rather than one or two large ones for that purpose.

I have considered somewhat at length the construction,

location, use and action of ventilating tubes, on account of its being necessary to make use of them under certain conditions, although I never recommend their use, if a better plan can be followed. My preference is for the Sheringham valve system of inlets and outlets, or another system to which I shall call your attention later. The Sheringham

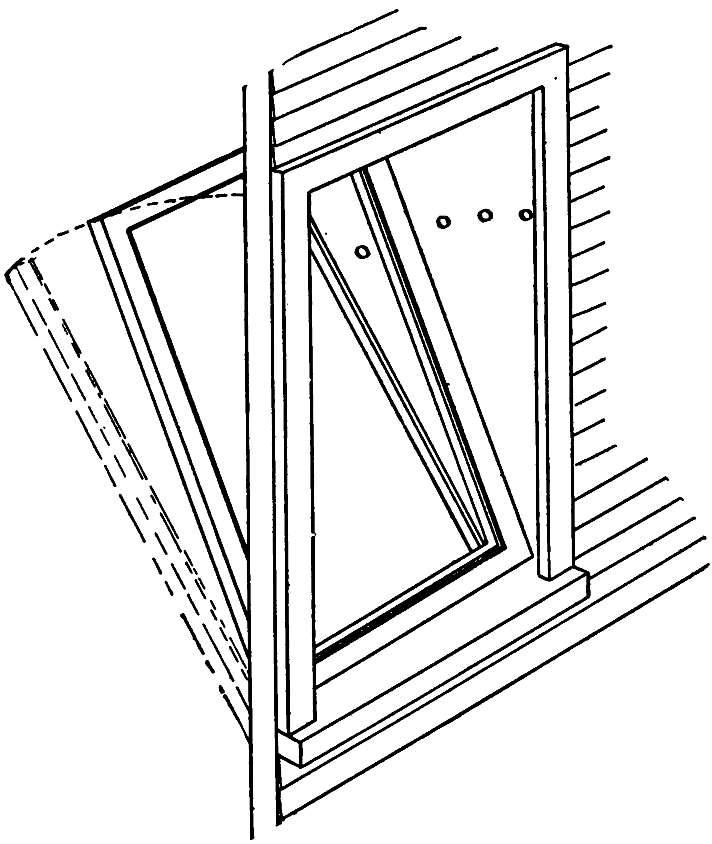

FIG. 5.—The Sheringham valve from the outside.

valve, a patented device of English origin, is in principle a window, either single or double, hinged at the bottom, swinging in at the top, having, when open, the triangular spaces between the edge of the sash and the edge of the window casing closed with wood or a piece of sheet metal. The action of the Sheringham valve is similar to that of a partially open window, hinged at the bottom, swinging in-

ward at the top (Fig. 5). The wind striking against the oblique window surface is deflected from its straight course, thrown into the upper part of the building, and, being heavier than the air already in the building, gradually finds its way to the floor, where it comes in contact with the animals. The closing of the triangular spaces on the sides prevents downward draughts directly upon occupants of the stable. Sheringham valves are found in the market with sash and frame made of cast or malleable iron. These are too expensive for use except in limited numbers.

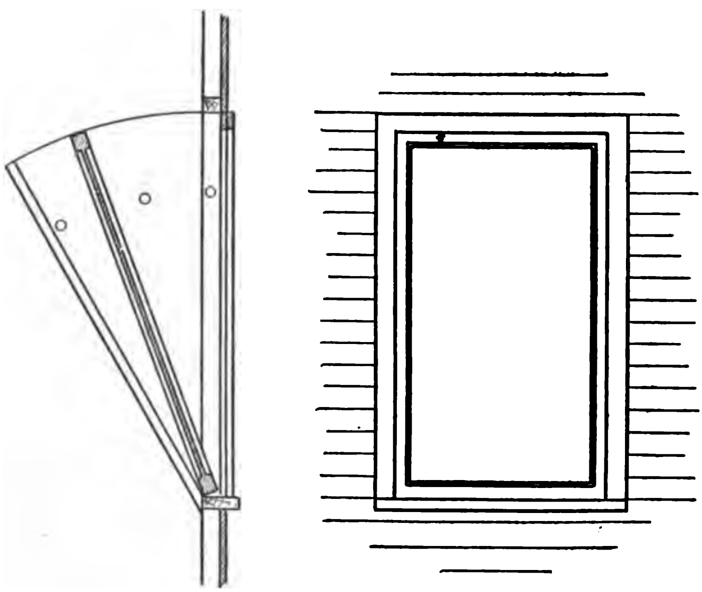

Fig. 6.—Cross-section of a Sheringham valve or window.

A modification of it, which includes all its desirable features, is an ordinary window, hinged at the bottom, swinging in at the top with the side openings closed. All the material required to convert a common sliding sash into a Sheringham valve is a seven-eighths-inch board, eight to ten inches wide, as long as the sash, planed at both sides; two or three strips of one-half-inch material, one and one-fourth inches wide; a pair of butts and one old-fashioned spring barrel bolt. The eight-inch board is split lengthwise between diagonally opposite corners. These pieces are nailed to the inside edges of the casing. The narrow strips of material are nailed to

the inside edges of the boards first described. These overhang the inner edges, and serve to prevent the windows from swinging too far in. The barrel bolt put into place in the sash, several holes bored for it in the triangular side pieces, the hinges fastened on, the window stops of the original window removed, and the Sheringham valve is complete. If the stops are of the right width and thickness, they may be used on the edges of the triangular-shaped board. Hinges

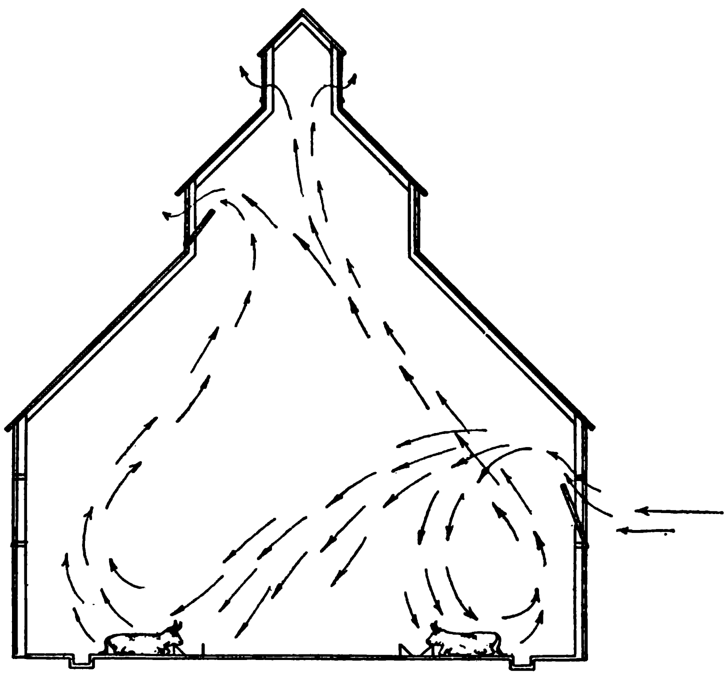

FIG. 7.—Cross-section of monitor-roofed stable, with the Sheringham valve system of inlets and outlets. The arrows indicate the direction of incoming and outgoing currents of air.

are not necessary, as a strip of board can be nailed across the inner corners of the protecting boards above and below; these, with the barrel bolt, will hold the window firmly in place (Fig. 6). The advantage of not using butts is that the windows are easily removed for cleaning or other purposes.

The form of stable best adapted to ventilation with Sheringham valves is one not more than forty or forty-five feet in width, of any length desired. A monitor roof is desirable,

but not essential. The animals should be arranged in rows on either side, facing a central drive or passageway (Fig. 7). There should be four rows of valves, two below (one on either side in rear of the animals), situated four or five feet from the floor, and two above near the plates, or, better, in the sides of the monitor roof, provided the building is constructed on that plan. The lower row of valves, on the windward side of the building, should be open to admit fresh air; those above, on the opposite side, to allow for the escape of the foul air. By having numerous valves, each of

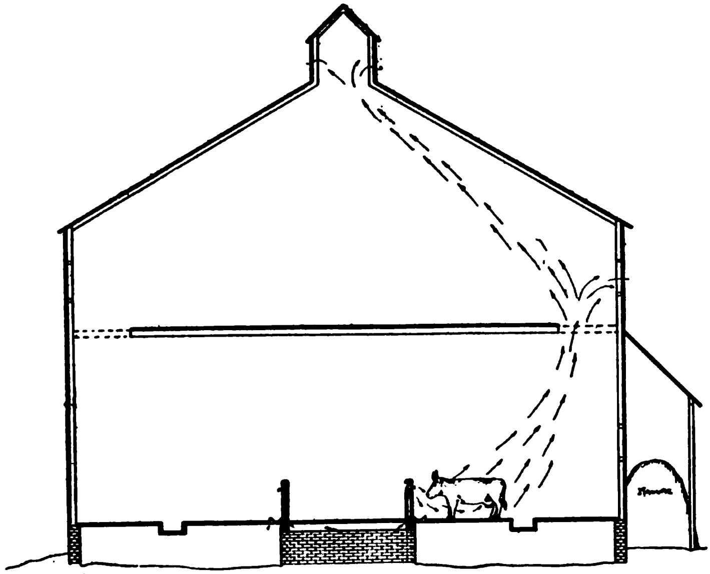

FIG. 10.— Cross-section of stable, with manure sheds, showing inlet for fresh air under the driveway floor, and direction taken by the incoming currents of air.

which is opened but a little, the incoming current of air is evenly distributed throughout the building, and objectionable draughts prevented.

Another plan of construction particularly applicable to stables with straight walls, with manure sheds on either side, provides for the introduction of fresh air through openings in the manger fronts, and the escape of foul air through windows or cupola openings above. This system of inlets is only used to good advantage in those barns where the

stable part is separate from the storage portion. There should not be a cellar under the stable. The arrangement of the animals should be the same as in stables where the Sheringham valve system is employed (Fig. 8).

Under the floor of the central driveway, running lengthwise of the building, there should be a space or chamber having outside openings at the ends of the buildings. This space should be about two or two and one-half feet in depth, of the same width as the driveway floor above. The openings at the end may be of any convenient size, preferably not smaller than six feet in length by one foot in width (Fig. 9).

The open space under the central section, which serves as a fresh-air chamber, must be completely separated from the two side spaces under the stall floors. Fresh air from the air chamber is taken into the stable through the manger fronts, which are built in the form of boxes, there being an opening at the bottom into the fresh-air chamber, and another at the top into the stable (Fig. 10). With this arrangement, air is brought into the building and delivered directly in front of the occupants, at the point where it is most needed (Fig. 11). From contact with the animals it becomes heated, rises, and, with the impurities that it has received from the animals, escapes through the outlets above.

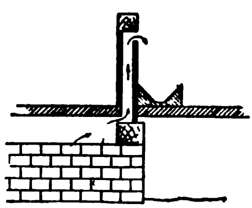
FIG. 11. — Cross-section, showing construction of manger front for the admission of fresh air to stable.

This system possesses the advantage of being quite automatic. The air is brought in through numerous small openings, preventing uncomfortable draughts. It is introduced at just that point where it is most needed, and, again, each animal gets its supply of fresh air regardless of its position in the stable.

In the construction of new or in the remodelling of old stables to improve the sanitary conditions about them, more especially to provide for effective ventilation, one or a combination of two or more of the systems mentioned in the foregoing pages may be employed. As to which system is introduced, must necessarily depend largely upon existing conditions.

FIG. 8. Rear view of new cattle barn at Moody's School, Northfield, Mass.

FIG. 9. End view of Fig. 8, showing opening under door sill to air chamber beneath central section floor.

In remodelling the old-fashioned, rectangular stable, in which there are bays on one side, scaffolds on the other, with stable quarters below the scaffolds and a cellar under all, it is advisable and advantageous in most cases to erect a separate ell for the animals, this ell to be connected with the old building on the south side. The stable space under the scaffolds may be used for storage purposes. Where this plan is adopted, the new stable portion should be built without a cellar, and, if possible, on a level with the cellar floor of the original building. This allows of the use of the cellar space for storage purposes, and makes the transportation of fodder, etc., from the main storage part to the stable easy. By the erection of an ell, which is practically independent of the storage structure, it is possible to introduce any of the modern and desirable systems for securing good ventilation.

We have made many mistakes in the past in the treatment of our cattle; we have treated them too much as if they were machines, not having recognized the fact that they were living organisms, whose bodies were made up of various sets of organs whose functions were under the control of a nervous system, sensitive to the action of all external conditions and forces. We have not stopped to consider that the functions of all these organs are closely correlated, or that the welfare of every one is dependent upon the healthful action of all the others. We have neglected to provide for the wants of the bony, muscular, respiratory and nervous systems in our mad career to increase the capacity of the reproductive and digestive organs. For all these shortcomings of the past fifty years we are beginning to reap our reward.

QUESTION. Is it always necessary to open on the windward side?

Dr. PAIGE. It is best to have the opening on the windward side.

Mr. PERRY (of Worcester). What is the best temperature?

Dr. PAIGE. As near fifty or fifty-five degrees as it is possible to have it.

Mr. PARKER. Do you consider a basement a good place for a stable?

Dr. PAIGE. The stable underneath the original structure in the proposed plan was filled with hay. I provided a driveway through the central section underneath the original structure. The animal portion of the proposed plan has no cellar underneath, the excrement being deposited in the manure sheds at the end, protected by an overhanging roof, but without sides.

QUESTION. How would you care for the liquid manure?

Dr. PAIGE. By having cemented gutters, water tight. These may be carried toward the end of the stable, so that the liquid excrement would be carried out. In case of a long animal section, the gutter should be carried from the two ends toward the centre, and open into a cesspool outside or into a tank.

Mr. Q. L. REED (of South Weymouth). Years ago they did not clean their stables.

Dr. PAIGE. They had at that time a tough lot of animals.

Mr. PIERCE (of Milton). I have often noticed that in an old-fashioned stable, closed cold nights, the walls would be covered with frost in the morning, and the air seemed much worse than when the night was a moderately cold one, and the stable was equally tightly closed. Was the air really worse? It seemed to me that there would be more change of air through the cracks, and that it ought to be better on an excessively cold morning, but it appeared to be worse.

Dr. PAIGE. I do not see how the temperature would affect the circulation of the air very much under such conditions as those. You must understand that a test of the purity of the atmosphere by the sense of smell is a very unreliable one. With the walls frosty I should imagine the air might be a little more vitiated in the stable than on a morning when the temperature was not quite so low. The tendency for the frost to form is greatest when the air is still, and there is little tendency for it to form when the air is moving briskly outside.

Mr. HOWE. People close all ventilators to stop the currents of air that attract the lightning currents. Does it prevent lightning from striking the building?

Dr. PAIGE. I am not in a position to answer. I have noticed that barns are fully as liable to be hit as houses, and my explanation has always been this: a barn in July or

August is filled with new hay, and the air would naturally be damp; it would be much more damp than in a dwelling-house. Of course we all know that moist air is a better conductor of electricity than dry air.

Mr. GEO. M. WHITAKER (of Boston). On the question of barns being struck by lightning, I took occasion to consult Captain Brophy. He informed me that in his opinion there was no danger from ventilators and cupolas, whether opened or closed. It was a popular opinion that it made a difference, but it had no basis on scientific fact. I merely repeat his opinion, without pretending to know anything about it.

Mr. WARE. I would like to refer back a little to an illustration that involves to my mind a very important principle of ventilation. I think it was in picture No. 20 of the Smith system of ventilation. The picture represented a column of warm air outside of the room, with an opening at the bottom and one at the top. The warm air was supposed to enter at the top and go across the room where you had illustrated the breathing line, and go down to the bottom, taking the whole of the air from the top to the bottom. I suppose the room was intended to be warmed by that warm air that came in for circulation. While it seemed to have a perfect effect on one end of the room as the picture represented, would it affect the other end of the room?

Dr. PAIGE. It is supposed to, and I think it would.

Mr. WARE. This system shows that you get the best circulation by having the relative position of inlet and outlet as represented by that drawing?

Dr. PAIGE. Yes.

Mr. WARE. That seems very rational. My point was, whether there would be the desired effect in both ends of the room.

Dr. PAIGE. I think there would be. In a very large building you would have more than one inlet and more than one outlet.

Mr. PARKER. There is one point I wish to speak of. About two years ago I constructed a cow barn, running it at right angles with the main barn and running it east and west. I have congratulated myself ever since that it ran east and west. The doctor says it should run north and south. The

windows on the lower floor are the same size as those used in houses, and are made of nine by thirteen glass. The glass are placed in the roof, as thick as they can be placed in a monitor roof. The sunshine reaches the cattle all the time that it is shining, so, instead of lacking sunshine, they get it almost as much as those on the south side of the building. His theory and my practice do not quite harmonize, and I believe mine is the better.

Dr. PAIGE. I have had a little practical experience, too. Your system may be the best for you to adopt under existing conditions. I think you will agree with me that, if the animals on the one side get the benefit of the sunshine, the temperature must be better from eleven o'clock to two o'clock than it would be if it ran the other way. The point I made was that the variation between the temperature of midday and midnight would be much greater than when the building runs north and south.

Mr. SESSIONS. I want to remark that cattle are creatures of habit, as well as are men. Some of us have acquired a habit by which we can smoke poison or chew it, and apparently thrive on it. A cow can accustom herself to conditions not the best, and apparently thrive when she might thrive better under other conditions. My own barn was constructed before the subject was agitated at all. My cows used to thrive fairly well, but there was an out about it finally. Tuberculosis got hold of them, and I lost one of the best herds in Massachusetts.

Secretary STOCKWELL. The reception to the Board of Agriculture, tendered by Mr. Wm. J. Hogg, president of the Worcester Agricultural Society, will be held in this hall, and the members of the Board and their invited guests are all invited to be present. Members are expected to be present with their wives or ladies. The reception will be from 7.30 to 9.30.

I will now suggest that Professor Maynard be given an opportunity to explain the exhibit of apples which he has kindly prepared for the benefit of those attending this meeting. Professor Maynard, as you may know, is the professor of horticulture at the Agricultural College, and horticulturist at the experiment station.

APPLES.

BY PROF. S. T. MAYNARD, AMHERST.

The subject is an important one. We have had a very heavy crop of apples this year, and the question is, whether there are better varieties than those we are growing. Any one who has attended the large fairs of our State, and of other sections, understands that there is a very large number of varieties. I suppose we have between one and two thousand named varieties of apples that are of some importance. Many of them are valuable in certain localities and not in others. It is a fact that almost any variety of large size and good color may become popular in a locality. For instance, the apple we call the Ben Davis is the most popular apple among growers in some parts of the country. It comes into bearing very early, can be handled in any way you choose, and will keep until June. Buyers are often more anxious to get it than almost any other kind. It is very poor in quality. We do not care to grow it for our own use, and we make a mistake if we think it *good enough* to sell.

The question we must ask ourselves is whether we can make the varieties we are now growing profitable or not. Are there better varieties than the Hubbardston, Baldwin, Rhode Island Greening, Roxbury Russet, etc., for profit in New England? We know we can grow these varieties to perfection. Take the Baldwin. Is there any apple that will sell better or give us more profit than Baldwins like these on the table? Take the Rhode Island Greening. When we have apples of that color [referring to specimens], is there any trouble in selling them, and for a high price? Can we grow them in that condition? For our local markets I think there is nothing better, perhaps, than these varieties, if grown to perfection, but we have to consider competition

from other sections, competition in our own markets and competition with the European markets. The King, Ben Davis, Newtown Pippin, etc., and many other varieties are grown for European markets. We have to meet that competition. The York Imperial is bringing three or four dollars a barrel when our Baldwins bring two dollars and a half. We must meet this competition.

We are looking for something we can sell for a higher price than the varieties we are now growing. We can do no better in our own markets than to grow the varieties local with us, and which can be grown to perfection; for the European markets we must study the varieties that are being put into competition. Of these varieties, we have the Ben Davis, which is called the "money coiner" throughout New York State and the west. No doubt there is more money in growing that to-day than in growing any other apple. It bears early, and very heavily indeed; the apples are of good form and will keep, but they are of so poor quality that in a few years there will be no demand for any apples if this is largely grown.

Another apple that is grown for shipping is the York Imperial. It is better than the Ben Davis and more beautiful; is as good a shipper, and possibly may be as profitable. The flavor of the York Imperial is fairly good; it is better than the Ben Davis. The Newtown Pippin and King we cannot grow to compete with other markets.

Another apple which may compete with the above varieties in the European markets is the Lawver or Delaware winter. It keeps well, and every apple is as perfect as though turned out in a lathe. It yields well; a small tree eight inches in diameter produced four barrels the past season.

We have tried a number of varieties that are comparatively new to our general markets. The Sutton Beauty is an apple equal to the Baldwin, or better in quality, and free from the brown specks spoken of this morning by Dr. Sturgis. The color is brighter and rather more showy than the Baldwin, and I think, as far as we know, it can be made to yield nearly as large a crop. Mr. Hadwen and Mr. Hartshorn have brought in specimens of the Sutton Beauty which the audience are invited to test at the close of this meeting. The Washing-

ton Royal is another apple which I think we can grow for the local markets, but not as a shipper. Most people would say that it is the best apple in its season for eating and cooking we have. The majority of the apples on the tree were large. A young tree six inches in diameter bore about a barrel the past season. The tree is a fairly good grower and an annual bearer.

Another variety, a late keeper and beautiful in form, is the Scarlet Cranberry, a western apple. Another, very small but profitable if well grown, is the Lady apple. They are most beautiful in texture and color. They do not grow large, but perfect in form and coloring. They grow in strings on the branches. They are very delicate, and bring five to eight dollars a barrel when well grown. The product of one tree nine inches in diameter sold for twenty-two dollars.

The Mammoth Black Twig is an apple grown in the west. It is a later keeper than the Baldwin, and a good deal like it in form. Another is the Hurlbert. We have five trees, from which we picked from five to seven barrels each. Almost every one was as perfect as these specimens, and most of them were larger. The Gravenstein is a very good eating and cooking apple. It is a very heavy, strong growing tree. The specimens on the table were sprayed. The only variety in this collection that was unsprayed is Shiawasse Beauty, a seedling from the Snow apple. It is covered with the specks and spots that the speaker this morning described as growing on the skin and finally penetrating the apple. This is the ordinary apple scab, which grows during the summer, when the weather is wet. All other trees were sprayed, just before picking or within two weeks of picking, with a simple solution of copper sulphate, three ounces in fifty gallons of water.

For a fall apple you are all familiar with the Fall Pippin and Holland Pippin. They are most beautiful yellow apples, of high quality, fairly productive and always of a large size. We can grow the Snow apple successfully in New England, if on heavy soil and if the trees are sprayed. The difficulty as ordinarily grown is that they are covered with little black spots. When these come early in the season they stop the growth of the apple at the point attacked and it becomes im-

perfect in form. If sprayed, or in a dry season, they are perfect, always bringing a high price in local markets. They cannot be shipped unless very carefully packed.

The Mann, coming from New York, is like the Rhode Island Greening in form, always very perfect. It is a very hard, thick-skinned apple; a very late keeper, being fairly good in May and June, but never of fine quality, though perhaps better than the Ben Davis.

For an apple for the local markets, the Crow's Egg or Gilliflower will always sell if grown like these specimens. They cannot be used for cooking. They are sold the same way as the Williams in its season.

For a sweet apple, the most beautiful and perhaps one of the sweetest is the Jacob Sweet. It is very fair, very large and very productive.

The Beauty or Kent apple is a large, fair apple, of good quality for cooking, bears regularly and is of fair quality. The Spitzenberg is in demand if offered in perfect condition. It is not a great bearer, and can only be grown to perfection with difficulty.

The Wealthy apple is perfect in form, generally having more color than the specimens shown. These were picked too early. It is an apple that, while tender, is not easily bruised and will stand shipping. It is an early bearer. The trees are inclined to overbear. It is an apple that from its beauty and fine quality will always sell, and will be taken just as fast as it can be put in the market. I think we can ship the Wealthy to England successfully. It does not bruise easily, and may be put in the market in September. If we can put the Wealthy into the European market in its perfection, it will attract attention. We ship our Baldwins before they are well colored and the market is injured. While the English markets want a hard apple, they want high color. The Wealthy, like the McIntosh Red, may be kept into the early winter. The question as to the McIntosh Red is, whether it will prove productive and if we can prevent its becoming scabby. It originated in Canada, and there has the reputation of being attacked by the apple scab and as being not very productive. I do not know any variety that cannot be kept free from scab by spraying.

The figures given you this morning show you some of the profits that may be made by spraying the apple crop.

The Maiden's Blush is an apple that takes in the market. It is especially fine for cooking. It is decidedly acid, and can be sold in limited quantities.

A new apple that is attracting some attention is the Wolf River. We had only eight or ten specimens on the tree that had been grafted with twelve or fifteen stocks, and it produced fruit for the first time this season. It always grows large and very handsome, and is attracting a great deal of attention because of its beauty. It is a good cooking apple, a little coarse in texture, but because of its size would be sure to sell.

Another apple, grown in Connecticut, is the Pewaukee. I think that will outyield the Ben Davis. We have trees ten years old that bear every year, the branches being loaded almost to the ground. It is fairly good in quality and always perfect in form, of pretty good color and always of large size. I think it will be a profitable apple.

In view of the uncertainty about the Baldwin and the poor quality of the Ben Davis, we ought to devote our attention to such varieties as the Sutton Beauty and others that are of very fine quality. By raising such varieties we can prevent the competition of the west. I think four years ago, when we had a large crop of apples, there were more Ben Davis apples sold in Boston market after about the middle of January than all other varieties together. You would find them everywhere. If we can put apples of fine quality into our markets we are sure to shut out such varieties and most of the western apples which are poor in quality. Some of the small varieties, like the Jonathan and Winesap, are of good quality, and do not affect our local markets, where apples of good size are demanded.

The best apple in quality, and when you have eaten one you will each want a tree for your own use, is the Dyer or Pomme Royal. It is almost as juicy as a pear. It is not known in the market, and would not be a very salable variety.

Mr. Lyman. Do you grow the Bard apple? It tastes more like a pear than any apple we have.

Professor MAYNARD. It is the same as the Dyer or Pomme Royal.

Another variety that is a great bearer is the Fall Queen, or Haas. It is always perfect in form and color. It has very white flesh, being a seedling of the Snow apple, but not of as good quality. I think it is coming into notice, and, from its great productiveness and beauty, is as valuable as a great many other fall varieties. Possibly it will become popular in the market for cooking.

The Bell Flower is as delicious as almost any apple we have. When well grown it is sure to sell at a good price.

We have a large number of fine varieties that are sure to be profitable if well grown, and grown sufficiently to educate the people as to their value. What any particular grower should plant must be decided somewhat from his own surroundings.

The Congress is a very fine apple, of some local reputation.

In discussing varieties of other fruits, I do not know that there are any better than the four or five varieties which are now popular and which are largely grown for local markets. The distant markets cannot compete with us so readily in pears as in apples. Of course California can ship Bartletts to us out of season, but when our local crop comes in there is no demand for the California pears. Nine-tenths of the Bartlett pears that we buy in cans are perhaps grown on Kieffer trees. I was in New York State this fall, and found them canning Bartletts and Kieffer together, but all were labelled Bartletts. The manager said others were doing it, and he had to. Of the pears, the Bartlett, the Seckel, the Sheldon, the Bosc and the Hovey are decidedly profitable in large markets.

Of the plums we have three types: the Domestica, the Japanese and the American plums. The difficulties in growing the Domestica are such that we are coming to feel that the Japanese plums are going to be much more satisfactory, because they come into bearing earlier, are of fair quality, and we are sure to get two or three crops from the young trees. We are not sure of getting as many crops from the varieties of Domestica. Even the ordinary grower is sure to get a few crops from the Japanese.

Mr. WARE. Why do you say a few crops?

Professor MAYNARD. Because it is not a long-lived tree. I recently visited Mr. Butler's orchard in Connecticut, where large blocks of Japanese plum trees were being destroyed by the black knot and the monilia or brown rot. Many of the varieties are not long lived. We are hoping a great deal from the new varieties recently introduced. The older varieties seem to be going by.

Of the peaches there are but few varieties better than the old standard sorts, *i.e.*, Mountain Rose, Old Mixon and Crawfords, Early and Late. The Elberta is productive and a good canning peach, but not of so good quality as the Crawfords. The St. John is an early, yellow-fleshed peach, of fine quality. The Dennis is a light yellow peach, with green twigs, fine for canning. The Champion is a large, white-fleshed peach, of good quality and productive. The Triumph, the earliest yellow peach, rots badly, as do all of the very early peaches, and will not prove valuable in Massachusetts.

Adjourned.

THIRD DAY.

The meeting was called together at 9.30 A.M., Mr. Sessions in the chair.

Secretary Stockwell presented the following vote of thanks, which was unanimously adopted: —

The Massachusetts State Board of Agriculture tenders its thanks to the Worcester County Horticultural Society for the use of its hall for the sessions of this winter meeting, and also to its president and secretary, who have done everything possible to render our visit to this city delightful. They have anticipated our needs and provided for every want with a courtesy that will be gratefully remembered by the members of this Board.

Mr. John G. Avery (of Spencer) offered the following vote of thanks, which was unanimously adopted: —

That a vote of thanks be given the Worcester Agricultural Society for its invitation to meet here and for its cordial co-operation in every effort to make this session pleasant to the Board and profitable to the farmers of Worcester County, and also to the retiring president of this society, Mr. Hogg, for the reception and entertainment which was so heartily enjoyed.

The CHAIRMAN. I have the agreeable pleasure of appointing, to preside at this session of the Board, Mr. Ellsworth, who has been for some time a member of the Board, and who is well acquainted with the people of this vicinity.

Mr. ELLSWORTH. It gives me pleasure to preside this morning, and especially to introduce to you the lecturer. The subject is "Sheep raising in Massachusetts." This industry has been somewhat neglected. I remember that a good many years ago it was customary for nearly all the farmers in the western part of Worcester County to keep a few sheep. I think by that neglect the farms have deteriorated in fertility and value. I hope to see the time when the hills of Worcester County and of Massachusetts will again be covered with nice flocks of sheep. The lecturer this

morning is a gentleman with whom I have been associated in the Legislature. I have visited his farm. While he has large interests in other ways, he is a farmer. He keeps sheep and cattle, and is also president of an agricultural society. It is my pleasure to introduce to you Mr. Frank P. Bennett of Saugus.

SHEEP RAISING IN MASSACHUSETTS.

BY MR. FRANK P. BENNETT OF SAUGUS.

The number of sheep in the six New England States has decreased from 3,820,307 in 1840 to 554,013 in 1900. In other words, these six States contained, sixty years ago, about seven times as many sheep as they possess to-day. The total number of neat cattle in the six New England States in 1840 was 1,545,272, and in 1900 was 1,411,852, showing that the falling off in cattle raising in New England in these sixty years has been comparatively slight, as compared with the decline in sheep husbandry.

I have recently passed about two months in the sheep-raising sections west of the Mississippi River, from Nebraska, through Colorado and New Mexico, to Montana, Oregon, California and Utah, visiting the herders, sleeping upon the ranges and gathering information from large owners of sheep, as well as from government reports and statistics; and the result of these inquiries has confirmed previous impressions, that the time is ripe for the restoration of the 3,800,000 sheep or more which used to be owned in New England. The great free ranges of the west are now fully stocked, and are confronted with serious problems of their own respecting future development.

The heroic figure of the cowboy, the man on horseback, is far less important in real life than in romance, and is constantly being displaced on the public lands by the humble and plodding sheep herder. The census of 1890 showed that there were but 5,851,640 cattle upon the ranges of the United States, against 51,363,572 upon farms; and even this small percentage of range cattle must be taken to the farming States, to be finally fattened and fully prepared for beef; and it is the general belief that, if all the cattle were driven from the free ranges of the United States, it would not have an

appreciable effect upon the supplies and prices of beef in this country. The census which has just been taken will undoubtedly show a still further diminution in the number of range cattle in the United States. But, even should the last steer and cow be driven from the public lands of the United States, there would still be little room remaining for an increase of the present flocks of range sheep in the United States. During the recent high prices of wool in the latter part of 1898 and in 1899, nearly every available water-hole in the range sections was patented by sheepmen, and, as the water rights practically control the range, there is very little opportunity for any more sheep to be used upon the ranges. Hence, as the population of the United States increases and our imports of foreign products diminish, a portion of the growth of the country in sheep husbandry should occur in New England.

Our subject is "Sheep raising in Massachusetts," but we have broadened it to the consideration of sheep husbandry in New England, because the conditions are similar in all of the six eastern States. The following figures for each of these States show that the decrease of flocks has been marked in all of them, though somewhat less proportionately in Maine than in the other States: —

	1900.	1840.
Maine,	237,502	649,264
New Hampshire,	76,176	617,390
Vermont,	159,136	1,681,819
Massachusetts,	39,790	378,226
Rhode Island,	10,394	90,146
Connecticut,	31,015	403,462
Total,	554,013	3,820,307

Many farmers have lately been met who were willing to take from 10 to 100 sheep each, upon a three-years lease, for half the wool and half the increase. Assuming that each sheep produced but $1 worth of wool, and that the flock yielded 90 lambs at a value of but $3 each, the total increase of lambs and wool would be $370. Supposing the cost of the 100 sheep to be $500, — and I am purposely figuring high upon sheep and low upon the products of the flock, — the owner of the sheep would receive $185, or 37 per cent

per annum upon an investment of $500; while the lessee would receive the same amount, together with whatever benefit might accrue to his pastures and fields from the grazing in summer and the dressing which accumulated in winter. I should be glad to be one of an association to furnish sheep to any farmer who desired them, upon that basis, as a long step in the direction of ownership of a flock for himself. If he kept the increase in ewe lambs, he would have the basis of a very respectable flock at the end of the three years. It would be impossible for the flock to yield results less satisfactory than I have named above, if it were kept free from disease and dogs. But an average degree of intelligence and care in management would yield far better results than I have named. It would be as easy to keep sheep which will yield $2 worth of wool per head as $1 worth, and it is equally easy to obtain more than $3 each for the lambs. If the lambs came early, it might be possible to obtain $10 apiece and upward for them when two months old. Or, if thoroughbred sheep were kept, — in which event, of course, the original cost of the flock would be higher, — a ready market at high prices could be obtained in the middle western States and in the far west beyond the Mississippi River.

The New England Wool Growers' Association has recently been organized as a corporation, and we have obtained for it as high as 600 members; and what we need is a co-operative feature, with a system of shares and loans not unlike our Massachusetts co-operative banks. Without some such method of co-operation it will not be possible to introduce the educational features necessary to induce the great majority of New England farmers to engage in sheep husbandry to any important extent. An addition of 3,000,000 sheep to the flocks now kept in New England would mean an increase of at least $15,000,000 per annum in our present product of wool and lambs; and an improvement in our agricultural lands which would do much toward retaining upon the farms a rural population of the high character of former years.

In any wholesale effort to increase the flocks of New England, of course the first question would be, where the

ewes should be obtained. In the great west, some years ago, when wool growing was increasing by leaps and bounds, the large enhancement in the number of sheep was possible through the purchase of the scrubby Mexican ewes at low prices, and the crossing upon them of Merino rams. If ewes for New England were to be purchased in the Brighton market, the danger would be of obtaining animals which had been rejected by farmers because they were impotent, or would not breed. Ewes of this description often come to Buffalo and other centres in lots of two or three from numerous points in Ohio, Indiana, Canada and other sheep sections, and are made up into carload lots. Many ewe lambs come to Brighton in carload lots, but are generally in such good condition that they would lose flesh if put out upon farms, and possibly their cost would even be too great to use for that purpose. The best way in which to increase the number of sheep in New England would be to induce the farmers to buy the ewe lambs of their neighbors, and to discourage the sale of ewe lambs for a series of years. Just now carloads of sheep could be bought throughout the west at very moderate prices, owing to the disappointment which has occurred during the past seven or eight months in the condition of the wool market; but in selecting ewes for New England in those sections, great care would need to be taken that they should be young and thrifty.

One of the necessities of successful sheep husbandry in New England would be the profitable disposal of the old ewes after they were no longer thrifty as breeders. West of the Mississippi River the large flocks of sheep develop some specialists in various kinds of sheep husbandry; for instance, I have met men in the west who made a specialty of buying broken-mouthed ewes, — that is, ewes which, either from age or accident, had lost their teeth, so that they were no longer able to pick up a living upon the range; and these feeders made a specialty of buying them and taking them up into Kansas, Nebraska and Colorado, where they fattened them upon grain and put them into the market at a profit.

In the far west the range men formerly often kept their ewes until they died of old age, the theory being that

enough of them would have lambs to offset the losses of the weak and aged animals during the winter; and under such circumstances some ewes twelve or thirteen years of age would still produce lambs. At the sheep slaughter house in Somerville a wether died recently which was known to be more than twenty years of age, and had been used as a "decoy" in leading the lambs to the shambles for nearly the whole of that period; but it is generally considered that ewes cease to be thrifty in New England at five or six years of age, and can then be turned into mutton at a profit.

One of the largest sheep butchers in New England informed me the other day that there never are any fall lambs in the eastern States which are fit for the Boston market excepting a few in Aroostook County, Me., in the neighborhood of St. Johnsbury, Vt., and around Colebrook, N. H. His idea is that all the good lambs for the Boston market, except a few from the three little sections named, come from the British provinces. He argued that there are no pastures and no form of green feed in all New England that will make lambs fat without the use of grain; but when the argument of any of these skeptics regarding the possibility of successful sheep husbandry in New England is carefully analyzed in detail, it is found to be inconclusive. If it is argued that sheep cannot possibly be kept here, because of dogs, the answer is that the dogs may be kept out by proper fencing. If it is claimed that the fence is too costly, the reply is that the fence is no more costly here than elsewhere. If it is urged that the pastures are too poor, the answer is that the sheep will improve them; and if it is insisted that the lands are old, the reply is that the prices of land in New England are far cheaper than in the farm sections of the west.

The year 1840 was the first time when sheep were enumerated in the United States census, and the total for the whole nation was 19,311,000. For twenty years after that period there was little increase in the country as a whole. In 1850 the number given was 21,773,000, and in 1860 only 22,471,275. During the war and for a few years thereafter a very rapid advance was made, from about 22,000,000 to possibly 42,000,000, followed by a decline in the years

subsequent to the civil war to 31,000,000 in 1871. The number had risen again to 40,000,000 in 1880 and to 50,626,626 in 1884, which was the largest number of sheep ever enumerated in the United States. In 1898 the number had fallen to 36,818,643, since which time there has been an increase to the present total of 41,883,065. If the number of sheep in the United States again rises to 50,000,000 or over, a considerable portion of the gain should be in the New England States.

The change in the wool clip of our country has not corresponded fully with the change in the numbers of sheep, since improvement by breeding and by better care has more than doubled the weight of fleece; but the consumption of mutton and lamb for food purposes has undoubtedly increased in greater ratio than our gain in population; and yet we are by no means abreast of Great Britain in our consumption of mutton per capita, since England not only consumes all of the large meat production of its own flocks of sheep and lambs, but is an enormous importer of mutton from Australasia, the Argentine Republic and the United States. Some splendid consignments of fat muttons and lambs are shipped from Boston by nearly every steamer engaged in that class of trade.

If it were practicable to prohibit the slaughter of ewe lambs in Massachusetts for a series of say five or ten years, we could thereby re-establish our flocks. We have closed seasons for deer and other wild animals in the various States; though of course a law to prohibit the marketing of ewe lambs to the butcher would be viewed by many as sumptuary legislation of a more extreme character than the prohibitory liquor law or Sunday closing acts. In our rural districts many of the inhabitants feel that they must sell their ewe lambs, as well as everything else which they can profitably turn into cash, before winter sets in; hence they will keep the same ewes year after year, and sell all their ewe lambs, until the old ewes are finally disposed of as "canners," that is, to the various canning factories, at merely a nominal price. If the ewe lambs could be retained, or sold to other farmers who would keep them from the butcher, the flocks of New England would increase rapidly; but, in order to

retain them, the farmer must feel assured that he is going to be able to keep them for a series of years, and not be so pressed for funds as to be compelled to sell them, without breeding, the second year, when they would possibly bring less money than they would have brought as lambs.

The decline in sheep husbandry in New England undoubtedly began with the decline in household manufactures, and was enhanced by the competition of the great grazing regions in the free ranges west of the Mississippi River and by the ravages of dogs among our small flocks in the badly fenced pastures of the eastern States. When the wholesale sheep raising of the west and the passing away of household manufactures in the east first began to reduce the flocks of the New England farmer, he failed to build the industry upon new conditions. He also failed to resist the depreciation of his flock because of in-breeding, and to adopt a class of sheep that would endure such housing in considerable numbers as is necessary through the New England winters. That "worms kill more sheep than dogs" is the terse and true heading of a good many advertisements of various vermifuges throughout the United States; and a multitude of internal parasites are developed in the so-called mutton breeds of sheep by excessive housing. In the severe winters of our New England States, where considerable housing is necessary, the sheep should have some percentage of Merino blood, in order to survive the artificial conditions under which they are kept.

The breed of sheep which I have selected as the proper cross from which to obtain this resistance to the evils of winter housing is the Rambouillet. The "native sheep" of New England, being wholly of English origin, contract fatal diseases with such certainty, if kept in large bands, that the farmers of Massachusetts and Maine have been accustomed to assert in general terms that sheep will not thrive if kept in flocks of more than 30 or 40 head; but, with a fair percentage of Rambouillet or other Merino blood in them, there is no limit to the number of sheep that can be kept in a flock in Massachusetts or others of the New England States.

Before referring briefly to the various English breeds of sheep, we will consider for a moment the origin of the Ram-

bouillet. On Oct. 12, 1786, Louis XVI of France placed on the government experimental farm at Rambouillet, France, 334 ewes and 42 rams, taken from 10 of the best Spanish sheepfolds, according to the recommendation of the king of Spain himself. The weights of the unshorn bucks were approximately from 110 to 120 pounds, and of the unshorn ewes about 72.5 to 88 pounds. The fleece of the bucks weighed about 8.8 pounds, and that of the ewes about 7.7 pounds. The object was to send out reproducers from this flock as a free gift to the choicest flocks in France. No new blood has been added to the flock since 1800. In the catalogue of the Oregon State fair this year I was told that the managers made a class of French Merinos and a separate class of Rambouillets; but I have not been informed how any such distinction could properly be made. From 1840 until the present time the object has been to produce Merinos, of which the animals were at the same time valuable for slaughtering and for the production of wool. In 1867 the bucks of the Rambouillet flock weighed, with their fleece, 192.5 pounds, and the ewes 135.3 pounds, also with the fleece included.

Another famous flock of Rambouillets in France is the Victor Gilbert, which was started in 1800 from Rambouillet, France, by a gift from Emperor Napoleon, who took special pride in the sheepfold at Rambouillet, and visited them often. Still another famous flock from which these sheep have been brought in large numbers to the United States is that of Baron F. Von Homeyer of Pomerania, Russia, who started his flock from Rambouillet, France, in 1850. From the three famous European flocks of Rambouillet sheep just mentioned have come the great number of Rambouillet sheep now in the United States.

I have now about 200 sheep and lambs of this description, and am finally disposing of any other breeds that I have had. Rambouillet rams which are offered for breeding purposes in the United States range as high occasionally as 300 pounds or more each. At the head of a famous French Merino flock in California, which I visited this summer, was until recently "Taxpayer," weighing 324 pounds and shearing 54 pounds of wool per annum; but this noble animal

died not long ago, and the present owner of the flock has rams which he expects will take the place of "Taxpayer" in weight of carcass and fleece.

But we do not argue in favor of mammoth size for the Rambouillet. What we claim is, that no cross-bred flock of sheep in New England can succeed unless Merino blood is one of its component parts, and that no flock of sheep can be profitably conducted upon a large scale without Merino blood. The Rambouillet ewes mature earlier than the Spanish or so-called American Merino, and can drop their first lambs without injury when two years old.

As to the production of thoroughbred rams in Massachusetts for the western trade, our advantages are fully equal to those of Michigan, where an enormous business of this kind is done. Our lands are cheaper, our winters no more severe, and we can obtain as cheap freight rates. On single animals, in crates, express charges are prohibitory; but on carload lots the rates from New England points as far west as Oregon would be precisely the same as from Michigan, Ohio and Illinois points. The rams should bring $25 per head in carload lots, and have sometimes been sold in such lots the past year at $50 per head west of the Mississippi. A combination between even 100 New England farmers would produce carload lots for the western trade, and enable each farmer to operate individually in the sale of single animals locally, as well as in raising wool, lambs and sheep for ordinary market purposes.

I hope I have not been misunderstood as disparaging in the least degree the great merits of the British breeds of sheep with which the farmers of New England are so familiar. The Southdown is one of the oldest breeds of sheep in the world, and is the product of many years of careful training by English farmers, — in fact, it may be said to be coeval with English agriculture. There are farmers in Massachusetts who have devoted more or less time through their whole lives to sheep husbandry, who would have no other ram than a Southdown for the production of early lambs. Just previous to his death, I think Mr. E. F. Bowditch of Framingham had decided that he would have no other rams than Hampshires for the production of early lambs. Then

the Shropshire is one of the most popular of the so-called "mutton" breeds of sheep. Then, for size of carcass, the Leicesters, Cotswolds and Lincolns all have their friends. Thoroughbred rams of all of these English breeds of sheep are in demand among the large wool growers west of the Mississippi River, for the purpose of introducing special features into their flocks from time to time. When the ranchmen are prosperous, they prefer to change their rams every two or three years, and many of them believe that cross-breeding by the use of thoroughbred rams produces a larger type of sheep than either of the parents; hence, when the Merino blood approaches the thoroughbred stage, they will use some of the English families of rams for a brief period, hastening to restore the Merino blood again when the coarse wools and other crosses of the English sheep become too apparent.

An association could be formed of a sufficient number of farmers in New England to produce thoroughbred animals of any of the English or so-called "mutton" breeds of sheep, and dispose of their stud rams and ewes in sufficient numbers in other sections of the United States to divide a handsome profit among themselves. But such sheep cannot be kept in flocks of more than 30 to 50, and they must be pampered and cared for with much greater zeal than even in England, where the milder climate permits the sheep to get their living out of doors practically throughout the year. It is sometimes said that these "mutton" sheep will poison a pasture so that it cannot be used many years consecutively. This is only true when the sheep are diseased, and transmit animal parasites to the soil. No study in insectology would probably be more interesting than that of animal parasites which are transmitted from other animals and through water and vegetation to sheep. Just why the Rambouillet sheep are so much less susceptible than Shropshires, Leicesters and other English breeds of sheep to the numerous forms of worms and other internal parasites, is a matter concerning which some gentleman present may be better informed than I am. I merely state a fact, which is as true as that some races of human beings will live under conditions which would be fatal to other races of the universal family of mankind.

With dogs I have had far less trouble than with worms, both in Maine and in Massachusetts, as I have found my barbed-wire fences substantially dog-proof. In Massachusetts I have used cedar posts, a carload of which I brought up from Maine, at a cost of 4 cents each for the posts and 3 cents each for transportation. The carload included 1,000 posts. We have set the posts 8 feet apart, using a crowbar to make the holes, and then driving the posts with a sledge about 2 feet into the ground, leaving about 4 feet above the ground. In Maine we have used old cedar rails taken from the "Virginia" rail fences formerly used.

The posts used in Massachusetts were small, averaging perhaps 3 to 5 inches in diameter. The wire weighs a pound to the rod, and has cost us as low as 2½ cents per pound, though more recently it has cost 5 cents per pound. It is now considerably cheaper, though I have not had occasion to get recent quotations. As there are 320 rods in a mile, it follows that 1 ton of wire weighing a pound to the rod would stretch over 6¼ miles for a single strand. A mile of seven-strand fence, therefore, would weigh just 2,240 pounds, and, at 5 cents per pound, would cost $122. To make a perfect fence a staple would be needed for each wire at each post. The labor of building the fence is trifling. There is hardly anything on the farm so cheap as a barbed-wire fence.

Our fences are practically dog-proof where we use but six strands of wire and one wooden rail to steady the posts, but seven strands are better. We put the first strand very close to the ground, so that the sheep and dogs cannot crawl under. Where the ground is irregular, the wire would rest upon the earth in places, and should not be more than 3 inches from the ground at any point. We put the second wire 4 inches above the first, the third wire 5 inches above the second, the fourth wire 6 inches above the third, the fifth wire 6 inches above the fourth, the sixth wire 8 inches above the fifth, then a wooden rail 8 inches above the sixth wire, and a seventh strand of wire 8 inches above the wooden rail. This, of course, may be varied somewhat, according to circumstances, but it is substantially the kind of fence that we use, and it has proved effective. It is perfectly satisfactory,

also, for cows, but of course must not be used where horses are pastured.

Some people think the barbed-wire fence is improper for sheep, because little tufts of wool are seen hanging upon it in sheep pastures where it is used; but all the wool that is ever lost in this way in a flock of 500 sheep would hardly amount to the value of a single animal. The sheep speedily get acquainted with the fence, and leave it alone. The dogs cannot crawl under or through the wires, and they will not jump over; because my experience is, that a fence of that height is never troubled by a dog unless it is something that he can put his paws upon when jumping over. I have made some examination of woven wire and other forms of fences for sheep, and am convinced that for my own use they are not equal to barbed wire, and are several times as costly.

I early took the ground that, if we saw a dog in our sheep field, he should be promptly shot, and then we would decide afterward whether we had a right to shoot him. My men said the dogs were licensed; but I said I did not care, — they must be shot. Curiously enough, yesterday I saw a decision of the supreme court of Massachusetts on this subject. A valuable dog had been shot on a man's premises in the act of worrying hens. The owner of the dog fought the case through the supreme court, and the supreme bench returned a verdict justifying the killing of dogs under such circumstances. I think that is a very useful thing for us to know. A predatory animal, being engaged in killing domestic animals, there being no other way to prevent it, can be killed.

Since the above was written I have been compelled by unfortunate circumstances to add the following postscript. I had been interested in sheep more or less all of my life, and quite largely during the past ten years, without any trouble of consequence from dogs, but during the past few weeks I have lost a ram and three valuable ewes from dogs. In one case an occurrence in Saugus, which occupied much attention in the daily papers, caused thousands of visitors to swarm over the fields in our neighborhood, and they would leave the gate open and walk into our sheep pasture. In one instance such an invader was accompanied by a dog that

killed a sheep, and we promptly killed the dog. Shortly after three large dogs got into the pasture and killed a ram and two ewes, and were seen endeavoring to effect their escape through the barbed-wire fence after the crime had been committed, but too late to go to the house to get a gun to kill the dogs. It was subsequently discovered that the dogs got into the fields by climbing upon pieces of old stone walls which had been carelessly left in too close proximity to the fence. The sheep were promptly put into another enclosure, surrounded by barbed-wire fence, without any walls adjoining. In this case, if the wire had been placed on top of the wall the canine invasion would not have occurred, but it was because the wall allowed a resting place for the dog, or a point of advantage from which he could jump over the fence, that he was enabled to enter the pasture. No losses have occurred since the sheep were removed to the new enclosure.

I make this explanation because I am no longer able to say that I never had any trouble of importance with dogs, as I could have said when I had this paper nearly completed. But this difficulty was due in a measure to our negligence, and in a period of ten years my losses have been very small.

The number of sheep in Michigan, Ohio, Texas, California and some others of the far western or western middle States has diminished greatly in recent years, but in such States as Michigan and Ohio the character and value of the animals has increased in many cases. The State of Michigan alone still had 1,389,073 sheep on the 1st of January of the present year, or nearly three times as many as in all New England. Michigan breeders receive very high prices for their thoroughbred sheep for the western trade, but in Michigan land is higher than in the agricultural districts of New England. Much of their land is no more fertile than ours, and their climate is fully as severe as ours.

The number of sheep in the British Islands is 33,562,406, with a population of 38,104,975, or nearly one sheep per capita. The number of sheep in the United States is but 41,883,065, with a population of 80,000,000, or about half a sheep per capita. Land is cheaper in New England than in Old England, but it is necessary to educate our people

into keeping that breed of sheep best adapted to our soil and climate. We cannot copy England or France or Spain or even the more distant parts of our own nation, but we must receive suggestions from each of those localities, and adapt them to the peculiar requirements of our own section.

It is at least an interesting coincidence that a diminution of population in the rural districts of New England and a deterioration of character has followed the decrease in numbers of sheep. The average population per square mile of all northern New England, — that is to say, of Maine, New Hampshire and Vermont, — including their cities, towns and villages, is less than the average population per square mile of 24 other States in the Union. Among the States having a greater density of population than Maine, New Hampshire and Vermont, are Virginia, West Virginia, North Carolina, South Carolina, Kentucky, Tennessee, Michigan, Wisconsin and Iowa. Who would have thought that rural New England had so fallen behind other rural States, and that similar figures would be shown for rural Massachusetts were it not for the great population of our cities, which enlarges the average for the whole State.

The American Sunday School Union, through Rev. Dr. Addison P. Foster, district secretary for New England, has lately printed some startling literature upon this subject, noting three influences that are working against the character of the rural districts of New England: first, the migration of New England people to the west, the full force of which movement has now passed; second, the movement of the population from the country into the city; third, the change that is going on in the population from native to foreign born, with the result that the rural communities of New England are losing their old-time Puritan conditions and coming more and more under the sway of foreign elements and ideas. Doctor Foster says: "The results of these three unfavorable influences are patent in the growing religious destitution, ignorance and immorality of outlying rural districts in New England." But the authority whom I have just quoted also sees light in the movement which is now growing toward the return of people of the old New England character toward the rural districts; and I wish I had the

time to submit to this meeting about two hundred letters of inquiry respecting sheep which I received in a single week recently, some of them from men who have been working in the cities, and who would like to get back on to the farms.

Toward this problem of the restoration of sheep husbandry in New England we must turn our attention, as to a perfectly practicable enterprise. In this paper I have not discussed some of the details and methods of successful sheep husbandry in New England as much as I should have liked to, but those features can be included incidentally with any comments or questions which may be introduced. My plea is for a united effort, upon the part of agricultural societies and all other organizations concerned, for the character as well as for the material prosperity of New England to enlist themselves in a movement for the restoration of sheep husbandry in our rural communities.

The CHAIRMAN. This subject is now open for general discussion.

Mr. PRATT (of North Middleborough). I would like to ask to what extent a flock of sheep will assist in keeping down bushes, provided the bushes are all cut to commence with. To what extent would the sheep give assistance in keeping a pasture clear of bushes?

Mr. BENNETT. I would say in a general way they will do a great deal. Sheep have a taste and a selection of their own, and they are very fond of tender shrubs. I believe about all New England fields, with the exception of a few swampy places, have a tendency to grow up to trees; there is scarcely any land that will not grow up to trees, if let alone. The sheep like to eat the tender shoots of most vegetation. They will not eat clover, if it grows in the shade and is sour; they will not eat fine grass in certain places, and I have never seen sheep eating brakes. I have inquired of others in regard to it. I think Mr. Bowditch said he once made them eat brakes by feeding them close and feeding them grain. It may be that when the brake is just appearing they would eat it. Sheep will clean up a pasture, and if you stock a pasture early in the season, so that they

can get at the vegetation when it is starting, and stock it sufficiently well, they will keep vegetation down.

Mr. Pratt. What we call huckleberry bushes come up in our section to a great extent.

Mr. Bennett. I think the sheep would be of great assistance if the bushes were mowed down first. When they are four or five inches high I do not think the sheep would eat them. If the sheep were put in the pasture early in the season, and the bushes had been cut, it is my impression that they would keep them down if the pasture is sufficiently well stocked.

Mr. Pratt. I had the pleasure of seeing Mr. Bennett's farm this last season, and I gained the impression that the sheep were nearly taking care of the pasture.

Mr. Bennett. I think they will, but they will not take a large-sized bush.

A. E. Blount (of Colorado). I want to ask why the Australian breed produces the finest wool in the world and is so poor in carcass. I have had experience with sheep in the south and in the south-west and west, and I find that the South American sheep do not produce wool, but hair, and the mutton is very inferior. Three hundred and ten thousand lambs were introduced in the vicinity of Greeley last week for feeding purposes. They are fed on alfalfa. It is very dangerous to feed to cattle and to sheep when it is wet. The sheep are fed the alfalfa from the stack. The sheep are kept in flocks of 1,500 to 2,000 or 3,000. We have no grub there. We have no disease among the sheep. The only difficulty there is the interference of the cattle men. The sheep will destroy any pasture in the west. The western pasture is subject to a very small amount of rain during the year. We lose sheep by storms. I wish to ask about the breeding for fine wool.

Mr. Bennett. So far as the question relates to in-breeding in New England, there are probably those in the audience who know more about it than I do, because the results and conditions are exactly the same in all the other animals and in mankind. I would like to touch upon that a minute. Australia is not a good mutton country, and New Zealand is. I think that is almost wholly a question of the kind of sheep

that the owners thought best suited to their climate and soil. In Australia they run for wool, without paying any particular attention to mutton. In New Zealand they pay attention to mutton, and wool is a side issue. The reason they do not raise mutton in Australia is that they do not want to, for the wool is more profitable. The only place, — I say this with some fear and diffidence, because of the different opinion held in Vermont, — in my judgment, where they still cling tenaciously to the small body of the Merino, is in Australia, because they fit into the requirements of their wool industry; for they want wool and not body, and the difficulties of the situation seem to be met in that way.

The Mexican sheep is a wild, primitive sheep, descended from sheep brought over by Columbus on his second voyage and left at Panama; and the Spanish brought sheep from Spain. From these sheep have descended the numerous flocks of sheep in Mexico, which have reverted back, just as mankind would revert back, were it not for the influences continually pressing him forward. The Mexican sheep have reverted back to the original type. Instead of wool, they grow hair, and are small in body. One important thing about them is that they respond with most marvelous rapidity to the introduction of improved blood. In an astonishingly short period you can convert a flock of Mexican sheep into a flock of good wool-bearing sheep, by the use of improved rams.

This Rambouillet breed that I have been talking about, its descendants are scattered through the United States and Europe and South America. This Rambouillet type is like the Jewish race, — the product of in-breeding. The Jewish race is one of our strongest, most enduring races, and it is a race in which in-breeding has been the rule. On the general subject of in-breeding I am not so well informed as many in the audience. As I understand it, in every-day work and every-day business it is to be avoided. The ranchman of the west changes his rams every two or three years, if he can afford to. He practises discrimination and care and study in the selection of the best animals. I think a great deal of injury has been done to sheep husbandry in New England by careless in-breeding, by the multiplication of defects, by the

in-breeding of defective sheep. In every-day business it is to be avoided, because it is a method which is only to be employed with great care and discrimination.

Mr. A. M. Lyman (of Montague). Does not a cross between the Merino and Southdown make the best class of sheep that can be grown?

Mr. Bennett. I think it makes an elegant sheep. I am not prepared to say that it makes any better sheep than a cross with some other breeds. The Southdown is the favorite sheep with many people. The cross with the Merino makes an elegant sheep. The Merino blood gives the sheep the capacity for enduring housing through our New England winters.

Mr. Lyman. I have been engaged in buying sheep for the last fifty years, and I have never found any really better sheep for the market than a cross between the Southdown and the Merino.

Mr. Bursley. You would recommend any of the Downs crossed with the Merino, as a rule for Massachusetts?

Mr. Bennett. I think they make a fine sheep for Massachusetts. If perpetuated, you get onto the old question of grade animals. For the first cross it is all right, but after that it is the old question of the extent to which cross-breeding is satisfactory. People claim that it can be carried so far as to make the animals useless.

Mr. Lyman. Is it not more difficult to dispose of old sheep in the markets now than it was forty years ago?

Mr. Bennett. I imagine it is. I think the taste and the fashion in lamb and mutton have changed somewhat. I think there is a fad in wanting such fat mutton chops. They are the fashion at the present time. Old sheep used to be in good demand by the canning factories; it made no difference how thin they were. There is not as good a demand as there used to be for old sheep.

Mr. Lyman. I used to buy nothing but old sheep, and feed them and butcher them for the market; I sold no lambs; but now the market demands all lambs, or mostly lambs, and few old sheep.

Mr. Bennett. That is the New England market. The New England Dressed Meat and Wool Company at Somer-

ville kills every year about the same number as there are sheep and lambs in all New England, — that is, about 550,000 every year. I presume there are not over 50,000 killed in all the rest of Massachusetts. These old sheep used to be fed very largely in the Connecticut valley in the tobacco sections. At the present time there is no great number of sheep around here; they are brought from the west.

In regard to ewe lambs, I take it that there is a large number of poor farmers in New England who would like to keep their ewe lambs, and who believe that if they could keep them for a series of years it would pay, but they cannot afford to do it, for in the fall they must turn into cash everything that will bring cash.

Mr. Lyman. My impression is that the decrease in the number of sheep kept in Massachusetts is largely due to dogs. Dogs always select the best ewe and ewe lamb when after sheep.

Hon. Wm. R. Sessions (of Springfield). I have no doubt Mr. Lyman is correct in the reason for the decrease in the number of sheep kept, but I think the speaker has given a method by which the depredations by dogs can be almost suppressed. It requires a little capital and enterprise to fence a pasture. Some years ago I had the honor of submitting to this Board the cost of fencing pastures in something the way he has proposed to-day.* I think it is perfectly feasible in our towns. Most of the pastures are surrounded with the trees necessary to supply the posts, and the expense is simply for the wire and staples. With such a fence you can keep the dogs out. I do believe it will pay the farmers on the hills to attempt that very thing. It is the cheapest sort of a fence that is effectual in keeping sheep. As far as danger to other animals from the wire is concerned, I do not think it need be considered. On the prairies in the west, where they use only barbed-wire for fences, it is the practice to take the young horses to the barbed-wire fence and prick their noses. They are taught to respect a barbed-wire fence. If that process is not

* "Agriculture of Massachusetts," 1891, p. 124.

carried on, the horse will run into the fence and injure himself at the first opportunity; with that precaution there is no trouble. The same thing is to a large extent practised with mature horses. They are taught that barbed-wire fence is a danger to them. The feeling that barbed-wire fence is cruel, and should not be used by humane people, is simply a fad, and held by those who know nothing about it practically, as I look at it.

It is true that sheep are a great help in keeping down brush in every case. There are some troublesome bushes that they will kill out; for instance, the high and low blackberries. They will take every leaf they can reach on the white birch on some sorts of land, but that does not hold true on the mountains. There they find other herbage that suits them so well that they neglect the white birch. On sandy soil they will take every white birch they can find. By overstocking the pasture and making it up in grain, you can force or induce them to eat almost any kind of bushes. If the bushes are cut off in the first place, you can depend on the sheep to keep them down if they are kept a little short for food. They will keep down huckleberry bushes and almost any bushes.

I think if the farmers would go into the sheep business to a certain extent they would find that they had benefited themselves exceedingly.

Mr. Lyman. In regard to the wire fence, the great trouble is lack of co-operation among the farmers. It is almost impossible to induce them to put up a wire fence where they do not think they need it, and the man who owns the sheep must do the whole.

Mr. Blount. Mr. Sessions spoke of the wire fence being injurious to young horses. That is true. We obviate that by putting a blocked wire on top. The blocks are about two inches square, and are put in every six inches, making it possible for the horse to see it before he reaches it. We do not have the sheep surrounded by wire. The pastures are the public domains, and the sheep on the public domains are controlled by very few shepherds and dogs.

The very small amount of moisture in the air there does not carry the germs of the different diseases and we do not

have them. The air is so dry that it will not transport tuberculosis or consumption. We do not have the different diseases among the sheep.

Mr. Bennett. The east and the west have their own peculiar diseases. We have no scab in New England; the west has been tremendously ravaged by the scab. What Mr. Blount says about freedom from pulmonary diseases is undoubtedly true, but each section has its own difficulties. We have no scab; we have very little foot rot; we have a great deal more trouble with foot rot among cattle than sheep. So we balance the west pretty well by freedom from scab, so far as diseases are concerned.

The Chairman. The next subject is "Farm law." It is my pleasure to introduce to you Mr. M. F. Dickinson, Jr., of the firm of Dickinson & Dickinson, attorneys-at-law, Boston.

SOME ASPECTS OF THE LAW AS APPLIED TO RURAL AFFAIRS.

BY M. F. DICKINSON, JR., BOSTON.

About five and twenty years ago, during the administration of President William S. Clark of the Agricultural College, I used to spend a portion of one of the spring months in delivering a course of lectures to the senior class in that institution upon "Law as applied to rural affairs." The service was a very pleasant one. The young gentlemen entered into the study of the subject with commendable zeal, and I believe reaped some advantage from the course. It is possible that this fact may have been known to the secretary of the Board when he asked me to speak on this occasion.

At the December meeting of this Board, in 1878, Judge Edmund H. Bennett of Taunton, the dean of Boston University Law School, delivered an address before this body. He took for his subject "Farm law,"—the same topic which is announced for me upon this programme. I cannot expect to rival the high authority and classic style which characterized Judge Bennett's address, and its reproduction, in an expanded form, which appeared in print at a later day, but I may be able to supplement what he so well said. I should like to designate my subject as "Some aspects of the law as applied to rural affairs."

There is no inappropriateness in asking an American lawyer to address a body of American agriculturists. Our country is pre-eminently the home of both the lawyer and the farmer. In no other nation of the world have these two classes been so closely related in shaping the national growth and welfare. It cannot be denied that the American farmer has always furnished to the American lawyer his full

share of the litigation of the country. No class in the community is more jealous or tenacious of its rights than agriculturists; none enjoys more keenly the excitement and the uncertainties of a law suit. But litigation over small matters, which was prevalent in New England farming communities one hundred years ago, is less common to-day than it was then. The old reports furnish some racy reading, which chronicles the disputes and quarrels frequently arising between neighboring tillers of the soil.

Jeremiah Mason, that distinguished lawyer of New Hampshire, who in his later life was one of the chief ornaments of the Boston bar, and who died in 1830 at an advanced age, won great reputation early in his practice by his successful conduct of the "pig cases" and his attacks upon the "pig acts," so called, of the New Hampshire Legislature. The contest lasted several years, and became the chief subject of gossip in the State. A farmer client of Mr. Mason had a dispute with a neighbor over the title to two pigs, which were declared to be of the value of one dollar. He was anxious to have a complaint for larceny sworn out against his fellow townsman. Mr. Mason believed this was too extreme a measure, and declined to cause the arrest. He did advise an action of trover, as it is called, to determine the title to, and value of, the disputed property. A writ was duly placed in the hands of a constable for service. That officer, not finding the defendant at home, pushed the writ under the defendant's door, and made return that he had served it at the defendant's last and usual place of abode. The plaintiff, who lived near by, noticed the mode of service, and surreptitiously withdrew the summons and put it in his own pocket before the defendant's return, so that the latter had no notice of the suit at all until it had gone to judgment before a justice of the peace, and execution had issued. The defendant, naturally enough, made a great fuss about this little irregularity, and told Mr. Mason how that gentleman's client had been seen purloining the process of the court. Mr. Mason consulted with his client, and, finding the charge to be true, offered to have the judgment and execution cancelled, and to submit to a trial on the question of the ownership of the

pigs. But this did not satisfy the defendant. He thought, whatever his own offence might have been in taking possession of the pigs, that his neighbor was more deeply culpable, in that he had stolen the summons of the court. So he rejected Mr. Mason's offer, and applied to the Legislature to remedy his grievance. Without any notice to the adverse party, the Legislature passed an act commanding the justice of the peace to cite the plaintiff into court, set aside the default, try the action and allow either party an appeal. Mr. Mason appeared before the justice and denied the right of the Legislature to pass such an act, claiming that it was unconstitutional, in that it was an encroachment upon the prerogative of the judiciary. The justice had been an officer in the continental army, was rather a pompous citizen, and so readily accepted Mr. Mason's views, declared the act of the Legislature utterly void, declined to open the case and refused to allow any appeal. The next winter the plaintiff went back to the Legislature and procured the passage of a second act, directing the court of common pleas to allow an appeal; but in that court the same result followed. Mr. Mason defeated the attempt to open the case on the ground that it was unconstitutional, and the court refused to have anything to do with the matter. And thus it happened that the expressions "pig actions" and "pig acts" became terms of common import throughout the State. The more the subject was talked about, the more ridiculous it seemed, until finally it drifted into contempt; and since that day the Legislature of New Hampshire has never attempted to interfere with the prerogatives of the judges. Thus we see how efficient a smart lawyer and a litigious farmer may be in promoting law suits on the very small capital of two pigs, valued at one dollar.

Real Property.

At first thought it seems an easy thing to determine what real property is, but there are some difficulties about it. It is hard to give an exact and concise definition. Perhaps an old fashioned one will do as well as any other. "Real estate consists of land, and of all the rights and profits rising from and annexed to land, which are of a

permanent and immovable nature." We usually speak of all this as *lands*, *tenements* and *hereditaments;* and that is the language you will generally find in deeds of real estate in all the States.

LAND.

The term land comprehends all meadows, pastures, woods, marshes and land covered by water. It has an indefinite extent upward and downward. Two important corollaries following from this definition are: first, that all minerals belong to the owner of land, in the absence of special legislation reserving them for the government; second, that no man has a right to erect a building so that the eaves or any other part will project upon his neighbor's land. The old Latin maxim of common law on this subject is "Cujus est solum, ejus est usque ad coelum." Whatever is erected on land becomes part of it. Hence, if a man makes a deed of land without mentioning buildings, the latter pass by the deed; still, it is usual to mention the buildings. A pew in a meeting house used to be considered real estate, but now, under the more common modern forms of church organizations, it is generally treated as personal property. Seeds planted in the land, trees and bushes set out, though they have not yet taken root, are part of the real estate; but trees and plants in boxes or pots would be personal property. If trees are planted near the division line of two estates, so that the roots are partly in one and partly in the other, such trees are the joint property of the two owners; but if the roots are entirely one side of the dividing line, and only the branches overhang, the tree belongs to the estate where the roots are found.

Manure made upon the farm is considered such an essential part of the property that it is treated as real estate in the conveyance of land, and would pass to the purchaser without special mention; but manure made in a livery stable would be considered as personal property. The fish in a pond are a part of the real estate. The fruit hanging on trees, and potatoes or root crops not yet dug out of the ground, are real estate; but when separated, as when the apples fall from the tree upon the ground, or potatoes have been dug and lie upon the land, they become personal

property. The keys of a house, and the window blinds, though easily removed from the premises, are constructively attached to the real estate, and are treated as a part of it. Water has never been considered real estate, from the very nature of that element, — its movable character. It is incapable of being fixed, and is constantly changing.

If I wished to make a deed of an absolute title in a fish pond, I should describe the property as so much land covered with water, for the description of so many acres of water would amount to simply a license to fish in the pond.

Emblements.

The old French word *embléer* means "to sow wheat." From that comes a term frequently employed in the law of real estate, "emblements," which means crops growing on the land; that is, products which grow annually by "great manurance and industry," as the old phrase has it, such as rye, oats, corn and other grains, but not the fruit of trees and grass.

Questions frequently arise between tenants for life and tenants for years, which call for the application of the law of emblements. The original rules of the common law in reference to these have been considerably modified by statutes in the various States. In a general way, the rule may be stated thus: the heirs of a tenant for life are entitled to the emblements, because the law allows him to assume that he will live long enough to harvest his crops; but a tenant for a specified term is not entitled to emblements, because he knows the exact time when his tenancy will terminate. In other words, tenants for uncertain terms, that is, for life or at will, are entitled to the benefit of the crops they have planted, if their estate is terminated by their death or by the act of the lessor; and this right to emblements extends to all crops of annual planting and cultivation except grass or fruits of trees; and the rule goes still farther, so that, if there be an oral agreement for the sale of the land, and the buyer is allowed to take possession by the owner and to plant crops, but is afterwards ejected by the seller, the buyer may claim the crops, even though he cannot enforce the parol contract for the sale of the land.

Mortgages on Growing Crops.

The giving of mortgages upon growing crops is very common in the south and in some other parts of the country; and these have been upheld in many of the States, where written instruments have been made, mortgaging crops not yet planted. This seems to be an extreme and liberal extension of the validity of such conveyances. A contract was made in Kentucky in the early spring of 1862 for the sale of a cotton crop not yet planted. The validity of that contract was upheld by the supreme court of the United States, but it was put upon the ground that the law of Kentucky recognized the binding force of such an agreement. I suppose that crops may be mortgaged in Massachusetts, — that is, crops actually growing in the ground at the time the mortgage is given; but a mortgage given to-day on the crop of the next year would probably not be sustained. Our own supreme court said, as long ago as 1845, in a case arising in Norfolk County, that, although a person cannot grant or mortgage property of which he is not possessed and to which he has no title, still, he may grant personal property of which he is potentially, though not actually, possessed. For instance, one might legally mortgage all the wool that shall grow on the sheep he owns at the time of the grant; but he could not make a valid mortgage of the wool on sheep not his, and the mortgage would not become valid even if he should afterwards purchase the flock before the wool had been clipped.

An agreement to sell growing crops, including trees, has been held to be not an agreement for the sale of an interest in land, but for the sale of chattels; and so, not being within the purview of the statute of frauds, can be enforced, unless the value exceeds fifty dollars, or unless there has been a partial delivery of the trees or crops, in which case the delivery of the whole can be enforced. In a case arising in western Massachusetts, in 1841, the owner of land made a contract with a tanner that the latter might enter upon the land, cut certain oak trees, peel and carry away the bark, cutting up and leaving the timber and wood for the owner's benefit. After the trees had been cut and the

bark peeled, but before any of it was removed, the owner of the land changed his mind, and forbade the tanner to enter and carry away the bark. His contention was that this contract related to an interest in the lands, and was void by the statute of frauds; but the court said "No," because the bark when peeled had become the property of the defendant by the terms of the contract, and the plaintiff had no right to prevent his taking it away, because it was left on his land by his own consent. In another case, in Worcester County, one Ross, the owner of a farm on which he had a field of cabbages, went onto the land in the month of August with one Welch, and a bargain was made between them that Welch should purchase the cabbages there growing when ready to be severed from the soil. In November, after the cabbages had headed, they met again, counted them, and agreed upon the number that the defendant should have, and that he should take them away whenever he wished. He did, however, take only a part of those agreed upon, refusing to take the balance, on the ground that the cabbages were then growing, that they were attached to the soil, and were therefore a part of the real estate. But the court held that the taking of a part was a constructive delivery of the whole, and compelled the defendant to pay for the entire field of cabbages.

This subject is involved in a good many intricacies and exceptions, so that it is difficult, in this hurried way, to give a very accurate idea about it. It is enough for my present purpose to add a caution that, when any member of the State Board of Agriculture is buying a farm while the crops are growing upon it, he had better take good care to secure, by explicit terms in his deed, all that he supposes he is purchasing.

Fixtures.

To the general rule already stated, that whatever is annexed to the land becomes a part of it, there is one striking exception, which gives rise to what we call the *law of fixtures*. The term is a misnomer, for it denotes the reverse of its name. Fixtures are really those things annexed to the land in a kind of permanent way, which are still regarded as personal property, and are removable by the vendor of

the land against the will of the vendee. An enormous amount of litigation has grown out of this department of the law; not so often, to be sure, in connection with the sale of farms, or the transfer of farms by inheritance, as in cases of manufacturing and commercial establishments. In an old Pennsylvania case of some sixty years ago it was stated that the criterion of a fixture in a mansion house or dwelling is an actual and permanent fastening to the freehold; but this is not a criterion of a fixture in a manufactory or mill. That rule, however, would hardly pass muster to-day, for, even in the case of dwelling houses, in a good many instances great liberality has been shown to the vendor in allowing him to carry off certain articles as fixtures.

A large iron kettle set in brick, which farmers frequently have in one of their out-houses for the purpose of cooking food for swine or cattle, would pass as part of the real estate; but the same kettle, detached from any setting and used in different locations at different times about the farm, would be personal property. A steam engine permanently set for lifting hay or ensilage or conducting of heavy operations about the farm would be a part of the real estate; but a detached movable engine, capable of being transported from one farm to another, and doing work in either place, would be personal property.

The use to which an article has been put or is intended to be put may sometimes be determinative as to whether it is a part of the real estate, or personal property. For instance, when an article has been used for some employment distinct from that of the occupier of the real estate, it will be treated as a fixture, and becomes removable by the tenant or vendor, — that is, it will not be a part of the real estate; and lessees are in our day treated with more and more liberality in regard to the removal of trade fixtures. If a cider mill were set up by the tenant on a farm hired by him, and it were perfectly clear that the chief purpose was trade, and not the mere doing of the work of that farm, he would doubtless be allowed to remove it before the termination of his tenancy, even though the apparatus had all the elements of permanency.

A proper caution in connection with this subject is that,

if a tenant or a vendor claims the right to remove articles as fixtures, he should always be careful to make the removal before his tenancy expires, or while he is in possession; otherwise, he may lose the right of removal altogether. Another suggestion is, that, in view of the difficult and complicated nature of the law of fixtures, great care should be exercised in connection with the transfer of property, by specifying in the written instrument just what the parties have agreed to convey, and in some cases also by enumerating the articles not conveyed.

Purchase and Sale of Farms.

The original methods of transferring title to land in England, from which country we derive the great body of our real estate law, grew out of the practices of the feudal system. Under the feudal laws, all the lands in the country were vested in the sovereign, who parcelled them out to the great men of the nation, who were bound to render the king military service. These great lords in turn parcelled out their respective lands to vassals, who held them, and the land so held was called a *feud*, a *fief* or a *fee*. Originally these vassals took only temporary ownership, and the land reverted to the lord paramount upon the vassals' death; but gradually there grew up the right of transmission of the title from a vassal to his son or heir, and thus estates of inheritance arose, so that the modern use of the word *fee* implies absolute ownership. Under the feudal system, the lord took his vassal upon the land, and, by the symbolic method of handing him a twig or a tuft of soil, invested him with possession. He had no other title to it except that given him by the solemn act of the lord paramount, which created a contract between the two parties, — that of protection on the one side and service on the other.

In the progress of civilization, written instruments of conveyance or deeds supplanted the original method of conveyance, "livery of seisin," as it was called; but the practice of *recording* deeds, which is universal in the United States, did not obtain in England until a comparatively recent time. In this country the recording of deeds, though universal in all the States and Territories, presents no uniformity as to

the place of record. In our own State, deeds are recorded in a county registry kept for the purpose. In Connecticut I believe they are recorded at the town clerk's office, and the provisions as to record are quite various. No prudent Massachusetts farmer would think of buying a farm and taking a deed without carrying it, on the same day that he received it, to the registry of deeds in his county, and there putting it on record.

Statute of Frauds.

There are in all the States, or in practically all of them, statutes derived from an ancient English law, entitled the "statute for the prevention of frauds and perjuries." One of the provisions of this law universally adopted, I believe, by all the States, is that no action shall be brought upon a contract for the sale of lands, tenements or hereditaments, or of any interest in or concerning them, unless the promise, contract or agreement, or some memorandum or note thereof, is in writing signed by the party or his authorized agent. This we commonly call the "statute of frauds;" and the knowledge of its existence is important to the farmer, in order that he may be secure in his ownership, and may not be liable to have the fruit of many hard years of labor swept away by want of a sound title. There has been a great laxity in the rural communities of this Commonwealth in regard to titles of farms, and I cannot urge too strongly upon the intelligent farmer the importance of extreme care in the purchase and sale of land and of all contracts in reference to its sale or transfer.

An accurate survey of the premises intended to be conveyed is also to be advised; and, if boundary lines are found to be irregular and unsightly, steps should be taken, through negotiation with the adjoining owners, to establish symmetrical lines, well marked by frequent stone boundaries set deeply in the soil, which should form the basis of the description in the deed. As to the growing crops, manure, fixtures and all other debatable articles and property connected with the farm, these should be made the subject of specific written agreements, setting forth in clear terms what the intention of the parties is in reference to all such

matters; for the maxim is especially sound, in its application to the transfer of real estate, that an ounce of prevention is worth a pound of cure.

Boundaries and Fences.

The use of temporary marks and monuments as boundaries, such as "a stake and stones," or "blazed trees," very common descriptions in conveyances of wood land, is to be deprecated. It has now become more than ever important that the distance from one monument to another should be carefully taken and approximately stated in the deed; for I regret to say that the advent of the electric railway is fast removing any reliance upon courses fixed by the surveyor's compass, owing to the fluctuations caused in the movement of the magnetic needle by the electric currents. This fact makes it all the more important that other particulars in fixing boundary lines should be rigidly adhered to.

The contents of the land, as stated in a deed, are not the most important element of the description. It was held, a good many years ago, in our State, that when the boundaries are accurately pointed out in a deed, even fraudulent representations as to the contents did not constitute the basis of an action to recover damages.

I have already referred to this subject of boundaries in a general way, but I wish now to go into it a little more in detail, for I know of nothing over which farmers have had more trouble than their respective rights in adjoining estates. It is well-settled law that an abutter upon the highway owns the fruit of the trees growing in the road, and I presume it would be held that he owns the berries growing wild there, as well. A farmer who owns a tree whose branches project over his neighbor's land owns the fruit which grows on those branches, and if the fruit falls on his neighbor's land, the owner of the tree has an implied license to go and pick it up, he doing no unnecessary damage. Still, in spite of this right, one over whose line branches project may cut off the branches, though he can not appropriate them. That was decided in a recent California case; and that it may be dangerous to allow the branches of one's tree to project, appears in a recent Eng-

lish case, where the defendant was held liable for the death of the plaintiff's horse, which was poisoned by the foliage of the yew tree planted on the defendant's ground, but projecting over the plaintiff's pasture. But in another English case, where the horse had to trespass on the defendant's land in order to get at the yew tree, the decision was otherwise.

It has been held that an action will not lie for carelessly leaving maple syrup in one's unenclosed wood, whereby the plaintiff's cow, being illegally suffered to run at large, and having strayed there, was killed by drinking it. This decision was given in 1823, in the supreme court of the State of New York, by Chief Justice Savage, and is found in the first volume of Cowen's reports. About ten years ago Mr. Irving Browne paraphrased the decision by making it the subject of a witty rhyme, which appeared in the first volume of "The Green Bag," some portions of which I am going to take the liberty of repeating: —

One *Brainard* owned a favorite cow,
With placid eyes and gentle brow,
Renowned for milk, — he called it "milch,"
Her coat was smooth and soft as silch.
A star upon her forehead lay
Appropriate to her milky way.

. . . .

Bush owned a lot of wooden cows,
Which had no need to drink or browse;

. . . .

For he possessed a sugar bush
Where he a thriving trade did push.

. . . .

This bush was destitute of fence;
But, as there was no evidence
Of any law to keep it closed,
His syrup Bush left there exposed.

. . . .

At length, when *Mooly* in the grove,
In search of provender did rove,
She found this palatable drink,
And, hanging o'er the fatal brink,
So greedily did *Mooly* suck it,
That, giving one convulsive cough,
She speedily did "kick the bucket,"
And lay completely "*sugared off.*"

Brainard sued *Bush* for negligence
In keeping bush without a fence,
Or leaving syrup without care,
Well knowing that his cow ran there.

Savage, C.J.: —

This case to us presents two views,
Two horns between which we must choose.
This sugar-Bush did very wrong
To leave his syrup there so long,
Knowing that cows in search of pasture
Might thereby meet with sore disaster.

The other judges: —

Oh, Bush deserves much to be blamed,
He really ought to be ashamed.
He should have known that cattle lap
Inviting liquids, — *verbum sap.*

Savage, C.J.: —

But then, again, though it is shown
That Bush knew Brainard's cow frequented
His sugar bush, it is not known,
From evidence, that he consented.

The other judges: —

Yes, circumstances cases vary,
This may excuse the harm to dairy.

. . . .

Ah, this is quite another story,
'Tis negligence contributory.

Savage, C.J.: —

The law doth measure not degrees,
Where both the parties careless are;
Betwixt the cow and maple trees,
Damnum absque injuria.

All together: —

So this decree we ratify,
That *Brainard* pay the cost;
Perhaps it may him gratify
That Bush his syrup lost.
And, *obiter,* we can't discover
How Bush can ere for it recover.

And then the poetical reporter, Mr. Browne, concludes as follows: —

> A less poetic version, I'll allow,
> You'll find reported in the first of *Cow*.

An act of our Legislature, passed in 1884, provides in rather curious terms that no barb-wire fence shall be built or maintained within six feet above the ground along any sidewalk located in any public street or highway, and punishes the offender by a fine of not less than twenty dollars nor more than fifty dollars. The use of the words "above the ground" in that statute is quite significant, as you will see. The statute does not forbid the re-enforcement of a proper board fence by a barbed-wire top starting at the height of a tall man's head.

An act of the Massachusetts Legislature, passed in 1887, provides that the erection of a fence unnecessarily exceeding six feet in height built for the purpose of annoying a neighbor, is a private nuisance, and the person injured may maintain an action of tort to recover damages for the annoyance. This statute was up for consideration before the full bench of our supreme court in 1888, and objection was made to it that it was unconstitutional; but that objection was overruled in a carefully considered decision by the present chief justice. The verdict in the lower court was for the plaintiff in the sum of one cent; but the supreme court set this verdict aside and sustained the defendant's exceptions, on the ground that, if there was a *bona fide* use of the structure, beneficial to the defendant, even although the motive to annoy existed, the plaintiff could not recover. In other words, the court held that a structure must be erected for the sole purpose of annoyance, in order to invoke the penalties of the statute. Other provision concerning fences and fence viewers are grouped together in chapter 36 of our Public Statutes. In that chapter may be found many provisions that it behooves the intelligent farmer to understand and abide by; such as that fences four feet high and in good repair shall be deemed legal and sufficient fences; also brooks, rivers, ponds, creeks, ditches and hedges; that the respective occupants of land enclosed

with fences shall keep up and maintain partition fences in equal shares; that, in case of neglect to build and repair by either party, the other may call in the fence viewer to make an adjudication, and methods of procedure and remedies are provided in such cases.

The rules prevailing in different States in regard to fencing land are quite various. In some of them the owner of the land is required to fence out the cattle of other people; in others, he is required to fence in his own cattle. It was early held in Massachusetts, in a case appearing in the sixth volume of our reports, that a farmer is obliged to fence only against cattle lawfully in the adjoining field; and in another case, arising twenty years later, that, if he turns his cattle into the highway to graze, and if they pass therefrom into an adjoining field through an insufficient fence, the owner of the land may recover, as the farmer's cattle are not lawfully in the highway.

It also seems to be law in this Commonwealth, as set up in a more modern case, that the farmer is responsible for his animals if they escape while he is driving them along the highway, and do damage to another's property; and about the time of the decision last quoted, it was also held by our supreme court that a railroad company, though bound by a law to fence its track, is not liable to the owner of cattle killed by straying on unfenced tracks, if the cattle were unlawfully on the land adjoining the railroad, from which adjoining land they strayed.

Highways.

The rights of farmers as regards highways on which their farms abut is a matter of great practical importance. Most of our country roads were originally cow paths, then became lanes, and finally highways. In later years many of them have had their boundaries defined by stone monuments set at regular intervals, so that our highways are now generally enclosed within definite lines and limits; but the ownership of the fee of the land of the highways in most cases remains in the abutters, subject to the right of the public to use the highway for purposes of travel; and if such a road is discontinued, the land reverts to the original owner,

his heirs or assigns. This ownership of an abutter to the centre of the road involves the right to use his half of it in any way not inconsistent with the easement of the public to pass over it; and such abutter may maintain an action against any one who digs up or interferes with his portion of the highway, or places rocks or rubbish thereon without authority. This doctrine was very clearly declared in a case which arose in the town of Egremont, in Berkshire County, in 1863 or 1864. The defendant, in order to effect a beneficial widening of the road, placed stones and rubbish on the north side of the travelled part of it, and thus improved it and rendered it more safe and convenient for travellers; but the court held that inasmuch as he was not the highway surveyor, and although what he did was evidently for the public benefit, he committed an illegal act, and was liable in damages therefor. But this rule would not have been applied if he had worked upon the travelled part of the road, and improved the condition of that portion only.

If a highway becomes impassable for any reason, a traveller may pass over adjoining land, even if he has to take down fences in so doing; but there must be no unnecessary damage done, and things must be replaced as far as possible. As late as 1851 a case of this kind arose in Mount Washington, in Berkshire County, where in the lower court the plaintiff was awarded damages against a defendant who had encroached upon adjoining fields during a temporary obtruction of the highway; but when the case reached the supreme court, Chief Justice Bigelow reversed the decision and set the verdict aside, holding, against the contention of the plaintiff, that the law of England, affirming the doctrine of right to use adjoining land in cases of necessity, had been adopted and recognized in all the American States. The doctrine has its origin in necessity, and must be limited by that necessity; mere convenience will not justify such an exceptional use of private property.

Every farmer and every farmer's boy is familiar with the statute of our State, which provides that, when persons meet each other on a bridge or road with any kind of vehicles, each person shall seasonably drive his vehicle to the right of the middle of the travelled part of the bridge or way, so

that they may pass without interference; and also with the provision that, when teams are moving in the same direction and one wishes to pass the other, the passing vehicle shall take the left of the middle of the travelled part of the way, and that, if the bridge or travelled part of the way is of sufficient width for the two teams, the driver of the leading one shall not wilfully obstruct the passage of the other. But there is sometimes difficulty in applying this law in exceptional cases and under exceptional conditions. In March, 1843, one Jaquith was driving from Reading to Medford in his sleigh. Near the village of Stoneham he met the defendant Richardson, driving a four-horse stage coach with fourteen passengers. The left-hand side of the highway, as the stage coach was moving, was covered with an unbroken mass of snow, so that the beaten and travelled track in the snow was entirely on the right of the centre of the highway, as it would appear when there was no snow on the ground. The plaintiff turned his horse out into the snow and stopped for the stage to pass; but when the teams met, a collision occurred, and the plaintiff was injured. The driver of the stage claimed that, inasmuch as he was on the right of the centre of the road as it was worked in summer, he could not be held liable under the statute; but the court thought otherwise, and said that, by the true construction of chapter 51 of the Revised Statutes, when that part of a road which is wrought for travelling is hidden by snow, and a path is beaten and travelled on the side of the wrought part, persons meeting on such beaten and travelled path are required to drive their vehicles to the right of the middle of such path. This it will be seen was really an application of the spirit of the statute, rather than of its exact letter.

It may further be observed that the law guards with jealous care the right of the public to pass over the highway and to use it for all proper purposes. Hence, the owner of the fee in the highway is never allowed to set gates across it nor to put up other obstructions, and any passer by may lawfully throw them down.

Roadside Trees.

The subject of highways naturally suggests the topic of roadside trees; and in that connection I wish to call attention to an act passed by the Legislature of 1899, codifying and amending the laws relating to the preservation of trees. In brief, it provides that every town shall, at its annual meeting, elect a tree warden, who may appoint deputy tree wardens, as he deems expedient. The town or the selectmen may fix the compensation of these officers. The tree warden is to have the care and control of all public shade trees in the town except those in public parks or open places under the jurisdiction of the park commissioners, and shall expend all funds for the setting out and maintenance of public shade trees. Towns may appropriate money for the planting of shade trees, not exceeding fifty cents for each ratable poll. The tree warden may plant shade trees in the public ways, or, if it is expedient, upon the adjoining land, at a distance not exceeding twenty feet from the public way, for the purpose of shading or adorning the same; but, if the trees are set on private land, the written consent of the owner of the land has to be obtained; and all shade trees within the limits of any public way shall be deemed *public shade trees*. Whenever a citizen, other than the warden or his deputies, wishes to cut or remove a public shade tree, he has to apply to the tree warden, and provisions are made for a public hearing on the question; or the warden may grant permission without a hearing, if the tree is on a public way, outside the residential portion of the town, and the decision of the tree warden is final.

This is a very interesting statute, and it is pleasant to note that recently the tree wardens of various Massachusetts towns, to the number of nearly one hundred, with others interested in arboreal culture, had a meeting in Horticultural Hall in Boston and a conference upon this subject of shade trees. Mr. J. Woodward Manning gave on that occasion an interesting lecture, showing how the natural beauties of a town or village may be enhanced by skilful grouping and trimming of the native trees and shrubs, and

a discussion was held as to the rights and duties of tree wardens under this statute. It is hardly possible to exaggerate the advantages which might accrue to this Commonwealth if the subjects thus encouraged by the Legislature were taken up and thoroughly investigated and worked by all our various city and town communities. A State with all its highways set out with shade trees would be a novelty indeed, and one which it can hardly be doubted would prove a great attraction to many dwellers in other parts of the country seeking beautiful homes for summer retreats or for permanent residence. Let us hope that the planting and protection of roadside trees may be made the special subject of action by all the towns at their next annual meetings, if such action has not already been taken. Perhaps appropriate action by the State Board of Agriculture would go far towards securing so desirable a result.

Hired Men.

The law governing the employment of labor is of considerable importance to the farmer, and this kind of contract should be made with care and exactness. The employer should be certain that the person with whom he contracts is more than twenty-one years of age and so is competent to make his own agreements. Of course, if the employee be a minor, the contract must be made in the boy's or girl's behalf by the parent or guardian, in order to have any binding effect. Payments of money by the employer to a minor employee are unauthorized except upon the order of the minor's parent or guardian. A careful observance of these legal principles will avoid disputes and possible litigation. Another decision of great importance is this: that contracts which are not to be performed within a year must be in writing, or they will be considered void under the provisions of the statute of frauds already referred to. In other words, a valid oral contract can be made for employment, say for the period of eleven months and any part of the twelfth month; but if it be for a year, neither party is bound by it, and the employee, if he should leave the farmer's service, could recover for the time he has actually worked; whereas, if the contract were in writing and for a

year or more, and the hired man were to leave without good cause, he could not recover for the period actually spent. The death of either party of course terminates the contract. The executor or administrator of an employer is not bound to continue the employment, neither is the one who takes the farm under a devise in a will. So also the filing of a petition in bankruptcy by an employer dissolves the contract with his help, and is intended to amount to a notice of its dissolution; but the employee may have his damages assessed and prove the amount in bankruptcy, the measure of damages being the difference between the pay which he was to receive and the pay which he actually has received under the new employment which he has been able to find.

Bankruptcy.

The constitution of the United States confers upon Congress the power to enact uniform bankrupt laws. Under the exercise of that power, four such laws have been passed since the foundation of the government, the first in the year 1800, the second in 1841, the third in 1867 and the fourth in 1898. These acts of Congress of course operate to suspend the insolvent laws of the various States so long as the federal legislation is in force. The act of 1800 had no voluntary feature, but certain classes of men, such as merchants, bankers, brokers, underwriters, etc., could be put into bankruptcy by their creditors. It is interesting to notice that farmers were not included in the list, so that they were not affected in any way by that act, which was repealed in 1803. The act of 1841, which was in force less than two years, had both the voluntary and involuntary features, and under it farmers could take the benefit of the act if they chose, but could not be put into bankruptcy by their creditors. The act of 1867, which was amended in important particulars by the act of 1874, was in force about eleven years. This also gave farmers the right to take advantage of the provisions of the act if they chose so to do, and also allowed their creditors to put them into bankruptcy if they were found to have concealed their property, or had done certain other acts in derogation of their creditors' rights.

Under the law of 1898, still in force, any person, includ-

ing farmers, except a corporation, is entitled to the benefits of the act as a voluntary bankrupt; but wage earners and farmers are expressly excepted from the operation of the involuntary feature of the law; so that under the present statute no farmer can be put into bankruptcy by his creditors, even though he has committed acts which in the case of persons engaged in commercial pursuits or manufacturing would be treated as acts of bankruptcy.

This rather curious anomaly in favor of the agricultural classes of the country is doubtless due to the large influence in the national congress of representatives from the so-called Granger States, without whose aid no bankrupt law could have been passed. On the whole, however, no great harm can result from the favor thus shown farmers, for the fact is, that as a class the agriculturists of our country have been generally more successful in keeping themselves out of the "sponging-house," as the poor debtor court is sometimes styled, and have cheated their creditors less, than any other class in the community.

Easements.

The law of easements is of peculiar importance to the owners of farms and country estates, and no other branch of real estate law has been more fertile in litigation. Some knowledge of easements is therefore almost a necessary part of the education of an intelligent farmer.

An easement is a charge imposed on one estate for the benefit of another belonging to a different owner. Separate ownership is an essential feature to the creation and maintenance of such a right.

The land enjoying the privilege is called the *dominant* estate; the one which bears the burden, the *servient* estate.

That which is an easement for one of the estates is a servitude for the other. When the entire ownership of both becomes merged in the same person or persons, the easement disappears. No man can create or retain an easement in favor of one parcel of his property as against another part of it. An easement once created remains upon the land so long as the separate ownership of the parcels lasts; and it runs with the land, passing, by the conveyance or descent

of the dominant estate, to the new grantee or to the heir-at-law as one of the appurtenances of the estate.

An easement must not be confounded with a mere personal license. I may say to my neighbor, "You may walk across my mowing lot to reach your pasture as often as you wish;" but such permission or license is revocable at any moment, and lacks more than one of the essentials of a valid easement. And it is instantly revocable, even if the licensee has expended money in making a comfortable path or in building a convenient bridge over the brook which the path may chance to cross.

Rights of Way.

Of all easements those relating to private ways are of highest importance.

A private way may be acquired in three ways only: (1) by express grant from the owner; (2) by prescription, *i.e.*, twenty years' adverse possession; (3) by necessity. The last is so unusual a source of this right as to require only a passing notice. If you were to sell one lot out of your farm entirely surrounded by your remaining land, the law would give the purchaser a right by necessity to reach his land over yours, even though nothing were said about it in the conveyance, but this right would cease when the necessity ceased; for instance, if a new highway were to be laid out, touching the lot enjoying the right of way, the easement would cease, even though greatly to the inconvenience of the owner of that lot, by increasing the distance he would have to travel or the grades he must surmount.

Easements by express grant or deed are of course to be preferred. Properly recorded in the county registry, their validity rests on the firmest of foundations, and their value becomes greatly enhanced. But the grant is very carefully limited to its original purpose. A way granted for a particular use can be used only for that purpose. Thus, the granting of a narrow passageway for the carrying and recarrying of wood can not be held to convey the right to drive teams over it for cartage of hay or grain. Teams will not be allowed to pass over a right of way granted for foot passengers; and a right of way to reach farm land for the

removal of crops, etc., will not be extended to allow the owner of the dominant estate to lay out his land into building lots and erect houses thereon, and make of the right of way a street for the purpose of convenient access to the houses.

But most of the difficulties encountered in this subject of rights of way arise from their creation by what is called *prescription*. This means not simply twenty years' continuous and uninterrupted enjoyment by the owner or successive owners of the dominant estate of a right of way over the servient estate; a good deal more than that is required. It must be taken and used under a claim of right, not by permission (for that would destroy the prescriptive character of the right), and it must have been enjoyed with the knowledge of the owner of the servient estate. It must be acquired "under an adverse claim of right," and against persons legally competent to object. A prescriptive right of way can never be obtained against a minor or an insane person; and ownership of the servient estate by such a person suspends the operation of the prescription during the period of such minor's or lunatic's ownership. But where there can be clearly proven twenty years' adverse use of a right of way, the easement is thoroughly established, on the assumption, that is, the doctrine is based upon the fiction, that there is supposed, after such a lapse of time, to have been an ancient grant conferring the right claimed.

The lawful use of a private way implies the right and the duty to keep it in reasonable repair. These belong and rest upon the owner of the easement; and, if the owner of the fee obstructs the way, the easement holder may pass over the adjoining land of the servient estate. The owner of the land may erect bars or gates at the entrance of the way, and, if the owner of the right of way leaves them down or open, and cattle escape or intrude, the latter would be liable for damage done by the estrays.

An easement may be renounced, extinguished or modified even by a parol license granted by the owner of the dominant tenement and executed by the owner of the servient one. When the Providence Railroad was laid out, the county commissioners, acting under statute authority,

granted a cart and carriage way to Mary White from her homestead over the railroad to her remaining land adjoining the railroad, and this amounted to a grant of the right of way. This was in 1841. In 1888 the business of the railroad had so grown that the continued use of the way became a source of great danger. Accordingly the road proposed, and the owners of the land then assented to, a new mode of access to the land by the railroad agreeing to purchase and open as a right of way a strip of land leading from a new street to the land, and the abandonment of the old way. The offer was accepted, the new way built, and the old way closed by the railroad company; but there was no writing as evidence of the acceptance of the new way, or of the abandonment of the old. The owner of the way soon repented of his oral assent to the change, and brought suit against the road for obstructing his original right of way. The road then filed a bill in equity to cancel the old order of the county commissioners and to compel an abandonment of the old way, and in this was successful; the court holding that, in permitting the road to construct the new mode of access and in using it, though only for a few times, the owner of the original right of way had really abandoned it.

The case turned largely upon the intention of the land owner in accepting the new route to his land in place of his original right of way across the tracks.

Water and Water Rights, Irrigation, etc.

The branch of my subject upon which I now enter opens up one of the most interesting and important of all the topics connected with rural law. The steady growth of our population in this State and the excessive demand for water by our numerous cities and large towns, and the consequent diversion of many water courses for this purpose, may well excite the apprehension of the agricultural population of our State. Our Legislature has for many years treated the applications of municipalities for the taking of water for public uses with great liberality, — I am inclined to think with too great liberality. A startling instance of this tendency is found in the work which is now going on in the

valley of the Nashua, by which whole villages are being blotted out and scores of farms destroyed for the purpose of increasing the water supply of our metropolitan population. There is danger, it seems to me, that the demands of our cities may be carried too far, and I have a firm conviction that the farmers of the State might well unite in protest against excessive grants in this direction. An excessive and unnecessary water supply for towns and cities offers a premium on the waste of water. My own observation warrants me in alleging that there is a very great waste in most of our cities. The remedy for this, I may say in passing, is the universal application of the meter system to all water supply companies, whether large or small, so that a water taker will only pay for what he himself uses, and not be obliged to contribute to the wastefulness of others. Thus the natural water supply of the State may be properly conserved for the benefit of those who are entitled to it by original ownership. It is time, I think, for the farmers of the State to join hands in staying this tendency to waste of water. By united action they can do much to create public opinion which will afford them ample protection. The compulsory use of the meter system will do much toward staying these enormous wastes.

In many of the States which have large areas of rainless land, water courses have played an important part in the industrial and economical development of the country, and irrigation laws have been enacted and great schemes for irrigation purposes have been launched. Numerous companies have been formed for the purpose of selling water and rendering land valuable that would otherwise be useless. It is possible that by artesian wells in addition to the natural water supply all the rainless portions of the United States may yet be brought under cultivation, for it is a well-known fact that desert land becomes extremely productive when irrigated.

An irrigation congress has recently been in session in Chicago, at which it was stated by an engineer who has made a careful examination of the subject that there are in this country 75,000,000 acres of arid land, which can be reclaimed and made profitable agricultural territory at an

average cost of $2 an acre. Here is a domain larger than New England and New York combined, which, if reclaimed, would support millions of people and add vastly to the wealth of the United States, and it is seriously proposed that the Government should loan its aid in forwarding this great work.

It is not impossible that the subject of irrigation may attract the attention of the Massachusetts farmer in the near future. While we have in New England an excellent annual rainfall, still, there are times when the farmer is exposed to great loss from periods of protracted drought. Natural water courses are numerous and well distributed, so that it would be easy to provide reservoirs and methods of storing water against the time when it is needed for use in such exceptional periods. Take, for instance, strawberries and others of the small fruits. An excessively dry May and June practically destroys the crop; but if our farmers would familiarize themselves with the possibilities of irrigation and the ease with which water could be introduced in a country as broken as ours, many of the losses from drought, to which they are now frequently subjected, might be averted. Grass lands in some portions of the State might be vastly improved in productive capacity by the application of this system, and its introduction in many places and on many farms could be accomplished with very little expense. But, if the farmers of the State are ever going to interest themselves in this subject, they must do it before all the water has been taken to supply the heedless waste of the metropolis and our other large municipalities.

It is an interesting fact that there may be found in different localities in the State evidence that our grandfathers and great-grandfathers were not blind to the advantages of irrigation. Upon my father's farm in the town of Amherst there are the remains of an irrigating ditch which once conducted water from the upper portions of a brook running through the farm to some portions of the grass land, which, from the light and porous character of the soil, are especially liable to suffer in dry weather. Ancient trees are growing in this abandoned artificial water course, which testify to the antiquity of its construction. My grandfather used to

say that he did not know how long before his time the ditch was constructed, but it was undoubtedly during the lifetime of his grandfather, who was the first occupant of the farm, in 1742, so that it may safely be alleged that the ditch was constructed about one hundred and fifty years ago. We may learn some useful lessons from the fathers, and this illustration may serve to enforce the suggestion I make, that the subject of irrigation is well worth the attention of the Massachusetts farmer.

But, whether irrigation shall ever prevail in Massachusetts to any extent or not, the rights of the farmer in the brooks he controls and the water that lies upon the surface of his land or that supplies his wells or feeds his springs will ever be one of prime importance. It has been stated in a general way by our supreme judicial court that "every person through whose land a natural water course runs has a right *publici juris* to the benefit of it as it passes through his land for all useful purposes to which it may be applied; and no proprietor of land on the same water course, either above or below, has a right unreasonably to divert it from flowing into his premises or obstructing it in passing through them or to corrupt or destroy it. It is inseparably annexed to the soil, and passes with it, not as an easement nor as an appurtenance to the land, but as a part of the land. Use does not create it, and disuse cannot destroy or suspend it, and unity of possession and title in such land with the lands above it or below it does not extinguish or suspend it."

As to surface water on land, running in no defined channel, the farmer has a right to deal with it as he pleases, even though his action may increase the flow of water on his neighbor's land or diminish the flow of water into a neighboring stream. In the absence of any grant or prescription creating a water course, no right to regulate or control the surface drainage of water can be asserted by the owner of one lot over that of his neighbor. The owner of land may change the level of his soil by elevating or lowering it, or by erecting barriers so as to turn it to a new course after it has come within his boundaries. The obstruction or alteration in the flow of surface water will not constitute

a cause of action in behalf of a person who suffers loss or detriment from it against one who does not act inconsistently with due exercise of dominion over his own soil. A man may improve his own land, even though by so doing he causes surface water to flow off in a new direction and in larger quantities than before.

This doctrine has had still further application in one or two cases in Massachusetts, where it has been held that a farmer owning lower land may fill it so that surface water will back up over his neighbor's land, instead of flowing off, as it had been wont to do. The only remedy for the injured party would seem to be, in turn to fill his own land a little higher than his neighbor's, and thus reverse the flow.

As to waters percolating through the earth, it may be said that one may dig a well on his own premises, even though the consequence be to cut off the percolating water from his neighbor's well. Whether he may do this maliciously, for the mere purpose of injuring his neighbor, has been much discussed. It was held in Maine that he could not do this maliciously; but in New York the courts have held that, even though the injury is done for the mere purpose of injury, there is no right of recovery. In Massachusetts there was a dictum occurring in one of Pickering's reports which seemed to indicate that the view taken by the Maine courts would be the view taken here; but our present court of last resort in Massachusetts has several times recently stated that the motive with which a man exercises his property rights is immaterial; so that it may be deemed probable that, if the question were now to arise squarely in Massachusetts, the court would adopt the rule in New York, that, even though the well were dug maliciously, and not for any useful purpose, the right of the party to dig the well would be maintained. The owner of land in the lower part of a stream can of course maintain an action against an abutter on the stream above for polluting the stream in any way; by such means, for instance, as making a cesspool in the land near a stream, the contents of which may leach into the stream, or by depositing manure near the stream, and thus contaminating it.

A man has no right to build his house or his barn so near

his neighbor's line as to allow the water from the roof to drip upon his neighbor's land; but an easement in his favor may be created by prescription by twenty years' adverse use.

The owner of land bounded by a stream not navigable owns to the middle of the bed of the stream; that is to say, if I should describe my land in a deed as bounded eastwardly by "Roaring Brook," that would pass title to the middle of the bed of the brook; but language may be employed in the deed so as to exclude this idea. For instance, if the grantor describes his land as bounded by the bank of the brook, the bank would be the limit.

No one may stop up an ancient water course, — that is, one that has existed for more than twenty years. About 1887 a case arose in Middlesex County where the plaintiff's land was injured by water setting back upon it, in consequence of the obstruction by the defendant on his own land of an ancient water course which flowed through the plaintiff's land from the defendant's land. The water course was described as "an ancient rivulet or stream," which had existed beyond the memory of man. The obstruction complained of was the laying of a pipe for conducting the water in the ditch or water course, and levelling the surface above it. It was contended that the pipe restrained the flow of water in the stream; and in this case the plaintiff prevailed, although the defendant had done no act except upon his own land, and had really undertaken to improve the condition of things.

Interference of any kind with the natural flow of waters in brook, rivulet or stream by the owner of land through which it passes must always take place with a proper regard for the rights of his neighbors both above and below him.

Fishing.

Both the common law and the statutes contain some interesting provisions concerning rights to fish in streams and ponds.

The riparian owner has exclusive right to fish to the middle of any stream above the point where the tide ebbs and flows, also to fish in any pond other than the great

ponds, so called. Great ponds by our statutes are declared to be natural ponds which are over twenty acres in extent. Now, in such ponds and in places where the tide ebbs and flows, the public has the right to fish, but no one has the right to go across another's land to get to a great pond for the purpose of fishing. But the right even of the riparian owner to fish in navigable streams may be limited by statute, as has been held in Massachusetts under the statute of 1869, which forbids the taking of certain fish at their spawning season. It was claimed, in a case tried in 1871, that this law had no binding effect upon riparian proprietors, on the ground that it was unconstitutional; but this contention was overruled, the court taking the ground that the right of fishery by riparian owners might be to some extent qualified by legislation, the Legislature having the right to prevent the extermination of migratory fish as well as of useful birds and animals, by forbidding the taking of them at all times when such act would interfere with their breeding and multiplication.

The riparian owner, though he may fish in a stream, may not block it so that fish cannot pass. The owner of a dam where migratory fish are accustomed to pass must provide a way for their passage. This has become the well-established law of the State, under the statutes and numerous decisions which have followed construing those statutes.

The rights of riparian owners have been limited by statute as to the time and methods of fishing. These provisions are numerous, and to undertake to state the special provisions would far exceed the proper limits of a paper of this nature. One curious case may be mentioned, in which the defendant was convicted and punished for netting trout, though it was on his own land, and though he himself had raised the trout.

Ice.

A brief statement in regard to the law affecting the cutting of ice naturally connects itself with the subject of fishing. In the case of Rowell *v.* Doyle, the lessee of an ice house and land on the borders of a great pond cleared the ice so that it might freeze to greater thickness. The defendant cut holes in the ice, and fished there. It was held that he

had a right to do so. His public right to fish was as good as the plaintiff's right to cut the ice. In another dispute, where the owner of an ice house scraped the snow from half the ice and marked it off, and the owner of another ice house cut it, the latter was held free from liability, on the ground that there was no private ownership until the ice was cut; and it follows that, if the farmer, in his zeal to fill his ice house for the uses of his creamery next summer, visits one of the great ponds of the State, he had better cut and carry home at night all the ice that he has marked out during the day, or some enterprising neighbor may step in during the evening and help himself in a way more legal than courteous.

Game.

It has been held in England that the owner of land has property in animals killed thereon; but if the game was started on the land of another, the property is in the hunter, and I presume that doctrine would be adopted by our supreme court as the law of Massachusetts. In New Hampshire they have game laws which forbid the killing of certain wild animals at certain periods. A curious case arose there some years ago, in which Chief Justice Doe wrote a very long and elaborate opinion, discussing the whole ground of rights in wild animals and the right to restrain the killing of them. A certain farmer had a flock of geese, which was in the habit of resorting to a pond near his house. One day he heard a loud cackling from the pond, and, seizing his gun, hastened to the relief of his feathered flock. Coming in sight of the water, he saw his geese swimming with all their might for the shore, followed by four minks, a dam and three young ones. It was during the closed season. The owner gave a shout of alarm, as the result of which the minks gave up the pursuit and betook themselves to a small island in the pond, where they sat huddled together, the mother in the centre. The farmer fired his shot gun at the group, and killed all four of them at one shot. He was arrested and tried for killing the minks during the closed season; but the court held that he was blameless, on the ground that one may kill a wild animal in order to protect his property, if necessary, even if that wild animal is protected by the game law. I have

always thought that the defendant in this case deserved his acquittal for his excellent shot, if for no other good reason.

Another curious freak of the law, I will not say of the court, was a case arising some fifty years ago in Massachusetts, where a defendant was prosecuted for malicious mischief in shooting wild geese, after having been previously informed that it would throw an invalid into a fit; and the conviction was allowed to stand. This hunter seems not only to have given the woman fits, but to have given the geese fits too.

Domestic Animals.

The law affecting the ownership of domestic animals is always very interesting to the farmer.

Bees are *feræ naturæ*, that is, wild animals, and in their wild state of course they are not the subject of private property; but when hived and reclaimed they become the subject of ownership. If the owner of a swarm is able to identify it, the property continues in him, even if that swarm has flown onto the land of another and swarmed there. Care should be exercised that the keeping of bees does not interfere with the rights of a neighbor, for in Delaware a man was enjoined against keeping bees that annoyed the owner of the adjoining land.

Doves are not the subject of larceny except when in a pigeon house or in the nest and unable to fly; and if doves are killed by a stranger, at any rate on the ground of the proprietor, an action of trespass may be maintained against him, and damages recovered.

Hens are strictly domestic animals, and are among the chief annoyances of the farmer's life, whether it be his own hens or those of his neighbor. In fact, it may safely be affirmed that the neighbor's hens are generally the greater annoyance. So far as I know, no satisfactory method has yet been discovered of freeing oneself from this annoyance. Of all the farmer's possessions, hens go astray most easily. They crawl *under* the fence and they crawl *through* the fence, or they fly *over* it at will. A carefully cultivated garden plot is their supreme delight, and the ravages of the big rooster therein are the source of more neighborhood bickerings and troubles than all other things combined, except dogs. Some

ingenious fellow once contrived a way of ridding himself of their unwelcome presence by poisoning his neighbor's hens. There had been repeated trespasses and warnings of an intent to kill them unless they were kept away, and the threat was at length carried out; but the sufferer was sued and finally had to pay roundly; for the poisoning was held by our supreme court to be an actionable wrong. Moral: never poison hens, seldom shoot them; always drive them back into their own domain, if you can.

Swine are generally pretty safe animals to have. The owner, however, must be very cautious about establishing his pig pen too near his neighbor's house, and thereby creating a nuisance; but if he is complained of on that ground, he had better hire a lawyer to defend him, otherwise he may get himself in the fix of the farmer whom I heard of who was indicted for maintaining a nuisance, namely, a piggery, who, having no lawyer, argued his own case, and summed it up as follows: "The neighbors say, Your Honor and gentlemen of the jury, that hogs is unhealthy; I say they aint; look at me, aint I healthy?"

Under the head of swine I might perhaps well add a subdivision of my subject, and call it "voracious hogs." An instance of unusual hoggishness is to be found in a recent case in the Pennsylvania State reports. One Stewart brought his action before a justice of the peace to recover damages from one Benninger for trespasses committed upon his premises by the defendant's hogs. He described his porcine tormentors in the following pathetic language: "They were of the slab-sided, long-snouted breed, against whose daily and nocturnal visits there is no barrier. They were of an exceedingly rapacious nature, and six of them, at one sitting, devoured fifty pounds of paint, thirty gallons of soft soap, four bushels of apples and five bushels of potatoes, the property of the plaintiff. They raided the plaintiff's spring-house, upset his milkcrocks and wallowed in his spring; and for several years foraged upon his farm, having resort to his corn, potatoes, rye and oat crops, to his garden and to his orchard and meadow. They obtained an entrance by rooting out his fence chunks and going under, or by throwing down the fences, or by working the combination on the

gate. These hogs were breachy, and the plaintiff notified the defendant, several times, to shut them up, and the last time told him if he did not shut them up, *he* would; and the defendant replied, 'Shut them up and be damned.'" To the credit of Pennsylvania justice be it said that the plaintiff was allowed to recover damages for the ill-bred and unmannerly conduct of the hogs.

Dogs. — But all other domestic animals fade into insignificance in comparison with the dog. While not so highly regarded by the law as useful domestic animals, property in dogs is recognized, and they are the subject of larceny. In fact, the ownership of a dog once established, it is sometimes very difficult to rid oneself of such ownership. There seems to be no way but to kill the creature. Hardly any case in the courts attracts the crowd so genuinely as the dog case. The horse case alone can rival it. My old partner used to say that in his young professional days he went down to Plymouth and spent a week in trying the moral character of a dog, and it took pretty nearly all the inhabitants of one country town to settle that important question. I myself had a case once where a street railway company was sued for running one of its cars over a dog owned by the plaintiff. He was a worthless cur, but his value was greatly enhanced when the street car made mince meat of him. We tried the case a day or two, but the jury were so confused by the conflicting evidence, and perhaps by the eloquence of counsel, that they disagreed. Almost always, when I meet the gentleman who appeared on the other side of the case, he expresses his regret that we didn't have another trial, to settle all the important questions that were left suspended by the mis-trial we had.

A curious dog case came up in Norfolk County in 1894. The plaintiff was driving an express wagon drawn by a pair of horses, in the rear of which and attached to it by the reins was another horse harnessed to a single wagon. The defendant's dog ran out and bit the horse attached to the single wagon, in consequence of which the horse died, and suit was brought. The defendant contended that it was negligence on the part of the plaintiff to lead a horse behind, harnessed and attached to another wagon. The plaintiff requested the presiding judge to instruct the jury that a man had a right

to lead a horse in the way and manner described, and the mere fact that he was so leading the horse was not such evidence of negligence as would exclude a recovery for the bite of the dog; but the judge refused to give that ruling, and submitted the question of negligence to the jury, which returned a verdict for the defendant; but our supreme court said that the ruling ought to have been given, because the leading of a horse behind a wagon was simply a condition, and not in any just sense a contributory cause of the injury. In the course of the opinion Judge Lathrop wittily remarks that to hold that the question whether leading a horse behind a wagon, as was done in this case, should be submitted to the jury as evidence of negligence in inducing an attack by the dog, would amount to the submitting to the jury the question whether the color of the horse, or of the wagon, or of the driver of the wagon, might have induced an attack; and the law doesn't pay this respect to the characteristics or prejudices of the dog.

It has been held in another case that the fact that a dog is killing hens is no justification for killing the animal, unless the hens can be saved only in that way; but apparently if the dog were worrying cattle or sheep, he might be killed. In another case, the defendant, in trying to stop a fight between his dog and the plaintiff's dog, struck at them with a stick. In raising the stick he accidentally struck the plaintiff, who was standing behind them, in the eye, and suit was brought for the injury; but the court said there could be no recovery without proving negligence on the part of the defendant and due care on the part of the plaintiff.

Almost every one knows that there is in this State a statute which provides that any owner or keeper of a dog shall forfeit to any person injured double the amount of the injury sustained by him, to be recovered in an action of tort. This statute makes it a perilous thing to own a dog, for it rarely happens that a defendant escapes being mulcted in damages in an action brought for the bite of a dog under this statute.

The only exception I recall is one where the plaintiff interfered with his dog and another dog, that were fighting, and was bitten; and the question was left to the jury whether he was in the exercise of due care in interfering in the fight.

Upon that issue the jury found for the defendant, and the supreme court said the ruling of the lower court was correct. The owner of a dog killed or injured by another dog which has the vicious habit of attacking other dogs may recover damages.

A ferocious watch dog must be kept in such a way as not to be liable to endanger persons rightfully on the premises of his owner. If your neighbor's dog habitually haunts your premises and barks and howls by day and night, you may kill the dog if you cannot otherwise stop the annoyance. It was so decided in a New York case a good many years ago, and it is a comforting reflection to think that probably our sensible Massachusetts court would hold the same doctrine.

QUESTION. What rights have people by the roadside in regard to rubbish and stone left beside the road?

Mr. DICKINSON. I do not know that there is any law to compel the town to clear it away. The town might be liable for damages if a person should be injured by their presence.

QUESTION. Has the town a right to leave stones on a lawn on private property?

Mr. DICKINSON. Certainly not.

QUESTION. There seems to be a law to prevent the abutter from removing trees by the roadside.

Mr. DICKINSON. I suppose the gentleman refers to the condition before the recent statute was passed. Then it was a very serious question what the abutter's rights were, and I think the recent statute was partly to clear up the doubt that might exist in regard to the matter. The tree warden is the custodian of the trees. If an abutter wishes to remove a tree he must apply to the tree warden, and the warden must give a public hearing on the question, so that everybody interested in the tree may be heard. The tree warden's decision is final.

Mr. SESSIONS. Would an abutter have the right to cut off limbs hanging over his land?

Mr. DICKINSON. I do not think so. The spirit of the law is to preserve the shade trees in their beauty. An application to the tree warden would be the proper method.

Mr. Ware. You say every town "shall" elect a tree warden. In case some town does not, what is the remedy?

Mr. Dickinson. Apply to the Attorney-General, and get him to ask the court to compel the town to do it.

Secretary Stockwell. I would like to speak on this, because it is of great interest to us now. This new law, which was enacted in 1899, repeals previous laws, or intends to do so.

Mr. ——. We have a little feeling in our town that it is hardly right that the tree warden should be supreme. He is above the selectmen and all other authority. We hope the next Legislature will be asked to enact a law to protect the individuals as well as the landscape.

Mr. ——. I would like to ask in regard to rights of farmers where they own land bordering on a pond. What would be the rights of those individuals, supposing that each one wanted to cut ice?

Mr. Dickinson. On ponds the law is different from what it is on streams. If he bounds on a stream, he owns to the centre. He can go anywhere on the pond. If he marks out his ice and leaves it until the next day, and some one takes it away, he has lost his right to that ice. In a case where a man cleared the ice ready to be cut, and a gentleman went on to fish and cut through the ice, it was held that the right to fish was as good as the right to cut the ice.

Mr. Sessions. The following questions have been handed me, with the request that they be submitted to the speaker: —

Can an owner of land oblige his neighbor to contribute his half to put up a sufficient fence to enclose and protect sheep?

"A" digs a well on his land. If "B" claims "A" has drawn the water from his, "B's," well, has "B" any action for damage?

Mr. Dickinson. In answer to the first question, I believe he can, if both are keeping sheep. It may be difficult to decide which part of the fence shall be constructed and kept by one party, and which by the other. I think an owner can compel his neighbor to put up a proper sheep fence, under the circumstances. It would be a question, in any case, what was a proper sheep fence.

The answer to the second question is, No, not in this State. If a man digs a well near your land, you are without remedy.

Mr. BENNETT. Suppose he shall force the water by pumping?

Mr. DICKINSON. If he draws from his neighbor's land, he would not be liable if the water be drawn for his own use. If the water comes from his own land, he is all right. One of the towns in Massachusetts bought some land near a river and sunk shafts and wells near the river. One of the mills has brought suit, claiming that they are pumping the water from the river, and that the town is liable for damages. That is a different case, — pumping water to sell.

Mr. SESSIONS. We have a case in Springfield. I do not know whether it is settled or not. The city of Springfield put in a pump and drew water from a pond. The owner of property near the pond has put in an action for damages because the lowering of the pond takes water from his well.

Mr. DICKINSON. I should think it was too remote to be the basis of an action.

QUESTION. Why are all dogs taxed alike? Other property is taxed according to its value.

Mr. DICKINSON. We pay a poll tax all alike; and yet some are hardly worth two dollars.

QUESTION. Are the islands in a public pond public, or may they be private property?

Mr. DICKINSON. I suppose they are the property of the State, and the State may deal with them as it sees fit. The public has a right to use the pond for boating, cutting ice, etc., but the islands would be entirely under the control of the State.

Mr. JEWETT (of Worcester). Suppose I have a pasture bordering a large pond, and my land goes to high-water mark. That water makes a fence, and my line fence runs to the edge of high water. When the water goes down, who is to continue the fence to keep the cattle in the pasture?

Mr. DICKINSON. If you own the land under the water, you must fence it. I do not see why you should not fence in your own land. You must fence to low-water mark, to protect yourself.

QUESTION. Does cutting wood from a lot bring it under the head of improved land?

Mr. DICKINSON. No, not unless the land is improved. The mere cutting of the wood would not make it any less wild land. You must fence your cattle in, and your neighbor must do the same; but he cannot compel you to fence his cattle out. I do not know that there would be any difference in the case of wood land fully grown, and sprout land.

Mr. PARKER (of Holden). I want to get back to the subject of the tree warden. I think it is one of the most important questions before the agricultural people. Suppose the land bordering a highway is a lot of wood land. Perhaps the land for a rod back would be covered with a heavy growth of wood. Could you, in any sense of the word, call a strip a rod wide shade trees?

Mr. DICKINSON. I should apply to the tree warden for permission to take out the trees not necessary for shading.

Mr. PARKER. We have always held that a man owned everything to the centre of the road, including the shade trees. Is this due process of law, when the Legislature enacts a clause that that property on the highway, worth perhaps two or three hundred dollars, shall be put in the hands of a tree warden? Is it due process of law for the Legislature to take this property from the farmer? Hasn't he a right to compensation? It seems such an innovation on what I consider the rights of the abutter, that I want it made a little clearer to my mind.

Mr. DICKINSON. I think the supreme court would hold that law constitutional. It is much the same as in the case of street railways. They undertook to say, when the electric cars were introduced into Cambridge, that it was not a proper use of the streets to allow the cars to run through them. But the contention was not sustained. It is within the power of the Legislature to say that the trees beside the road shall be treated as public property.

Secretary STOCKWELL. During the summer the secretary has had a great number of inquiries come in to know who owns the trees by the roadside. You cannot take gravel away from one man's land and carry it away to benefit

another man's land. We have had a law by which the tree warden or the town could designate certain trees, and say they were shade trees and were set apart for the purposes of travel. And now the law comes in and takes the whole, and says no man can touch anything on the roadside without the consent of the warden.

Mr. Bennett. I was chairman of the committee that reported that bill in the last Legislature. I do not claim any especial responsibility for it, because Mr. Ellsworth was on that committee, and took more interest in the matter than I did. It is often the case that public sentiment goes far beyond that of the abutter. For instance, we have in the town of Saugus an old elm planted by Professor Roby. He has been dead over a hundred years, but he was a friend of every one, and his memory is strong in that town to-day. The people have a stronger interest in that elm than the person who happens to live opposite it. When a person lives in a community like that, and sees the street railway companies and the telegraph and telephone companies cut down the trees and through the roots to run the wires, he sees the necessity for some powerful authority in the matter. The committee took a very judicial attitude. They recognized that, as with the tariff law, there are conflicting interests.

It was presented to us at that time that we were taking away from the abutter a certain right to cut the trees he owns. You have to have a certain amount of forbearance. You have to frame the laws so as to be of the greatest good to the greatest number.

You say you are giving the tree warden great power. In our large towns you have assessors, and you take away power from the selectmen and give it to them, because you want specialists who will take that particular department. You place upon some one man authority and power in regard to the shade trees, but you have a chance to get at him at the end of his term. These two different conditions of affairs came before the committee, the one representing these communities which are suffering terrible hardships from the reckless depredations by street railway companies and other public-service corporations, and who want protection; and on the other hand you have the people living in the remoter

districts, who want the right to cut the trees abutting their premises. I think the committee on agriculture did well to get as good a law as they did. It can, no doubt, be improved as time goes on.

I think care should be taken to discriminate between an actual hardship and a purely theoretical case of a man who thinks he might be prevented by a tree warden from cutting the trees along his property. I do not think a tree warden who prevented this would be re-elected the next year.

Mr. Parker. In answer to Mr. Bennett, I want to say that at the convention of tree wardens there wasn't a word of doubt expressed that the tree warden didn't own every tree, and they said they were going to own the bushes inside the limits of the highway. I asked a selectman of an adjoining town what he would do. He said if he wanted to cut a tree he would do it when no one was around, and after it was cut the property would be his.

Mr. Bennett. In case a shade tree is cut down by a tree warden because it is in the way, or a public nuisance, who owns the wood?

Mr. Dickinson. I should say the owner of the abutting land.

Mr. Bennett. That applies to the trees Mr. Parker speaks of. The tree warden does not own them. You simply cannot find phraseology in which to state that some trees may be controlled by a warden and others not controlled. When the wood is cut, it belongs to the abutter.

Secretary Stockwell. I want to leave Mr. Bennett and Mr. Ellsworth right in this matter. The Legislature of 1899 did a good work in bringing this before the people and bringing the matter to the front. That the law does not provide for all contingencies is simply a natural effect. The Board of Agriculture and the Forestry Association are working for the good of the State in this line, and the little mistakes will be rectified for the good of the whole State; and we shall find that the work of Mr. Ellsworth and of Mr. Bennett will redound to the glory of the State and the beauty of its landscape.

Mr. Rindge (of West Brookfield). How long must one pass over land or use a spring to gain an acquired right?

Mr. Dickinson. That subject I omitted. Of course it is one of the most important subjects to the farmer. The rule is that twenty years are required to give a right of way or a right to draw water. That is a prescriptive right. But a man cannot acquire a prescriptive right simply by using it. He must use that right of way continually and without interruption, adversely to the owner. He must go ahead in the face of the owner, and use the right of way. The use must be continuous, and against persons who are competent to object, — that is, they must be competent to make a contract. If you began to use a right of way and used it eight years, and the owner of the land died, leaving an infant son as the sole heir, no prescription would run during that period. It must be adverse to the owner, and must be done openly and not in secret.

Mr. Sessions. I want to explain a little the case the speaker spoke of, about the barbed-wire fence on sidewalks. The petition upon which the committee of the Legislature acted and reported was to forbid the erection of barbed-wire fences along any sidewalk in the State. Knowing, then, as has already come to pass, that it would become a necessity to use the wire, I objected that such a law would be out of character. But the friends of the matter who were so much interested in the barbed-wire fence along sidewalks in villages made a great deal of cry about it. So we finally compromised by forbidding the putting up of barbed wire along a sidewalk unless six feet from the ground. This was to prevent climbing by boys and dogs, and yet the trouble which the people complained of was remedied. If this matter of cutting trees could be arranged in some such way to exclude the entire rural district from the provision of the law, it would seem to cover the ground.

J. E. McClellan (of Grafton). I have listened to this discussion about the law of 1899. There are more members of the agricultural committee of 1899 in this hall than have been mentioned. I see at least four or five before me. I want to set us right. This bill did not come from the committee on agriculture. We had nothing to do with drafting the bill. It came from the Forestry Association, and would not hold water in one of its clauses as it came from them.

We worked on the bill for two months, and this was the best the Massachusetts Forestry Association, and the secretary of the Board of Agriculture, and the gentleman who was at the State House in the interest of the grange, and everybody who was interested at that time, could make of it. I do not think we need to borrow very much trouble about this law being too strict. In our town we have a tree warden, and I do not know but he is as good as many other towns have elected. Since this law was passed I have seen at least four or five shade trees cut down, and nothing done about them. The law is to protect shade trees. You cannot exempt a rural district.

You have to have a law to cover the briers and bushes, or some man will cut the most beautiful shade trees. Put everything there is in the hands of a warden. The town does not want the wood, it wants the shade trees. In the case of a tract of wood land, the owner and the warden could select a few trees for shade, and the rest could be cut.

I hope the combined wisdom of the tree wardens and the State Board of Agriculture will not spoil this law, and make it worse. I hope they will make it better and stronger.

Mr. Adams (of Barre). I have listened to the various remarks in regard to this law. It appears to me, as it did in the committee, that it would have to be changed at some future time. I am pleased to see the highway trees cared for. I found that the Forestry Association had some ideas at variance with the ideas of the committee. Some wanted all briers and bushes left, so that it would look natural. The tree wardens will probably have the interest of the towns at heart. I hope that in time we will get the law into proper shape. At the present time I do not feel that it is quite what it should be.

Mr. Howard. One question in regard to water. "A" owned a farm, and allowed "B" to go on it and put a lead pipe to the spring. The spring furnished water for his cattle in the pasture. "B" put the pipe in and run it while he lived, and at his decease the water ceased to run. In after years "B's" place changed hands. "C" came into possession of it, and all the time "C" lived there, — two, or three, or four years, — he had no water from the spring, although the

pipe was laid through onto "C's" land. "C" sold afterwards to "D," and "D" afterwards sold, never starting the water, to "E." "E" occupies it to-day. After "E" had occupied it a few days or a month, he discovered this pipe, and attached it and ran it to the house. The question is, whether "E" will have a legal right to this spring.

Mr. DICKINSON. How long did "B" use it?

Mr. Howard. "B" used it about ten years. The understanding was, that when water was short in the pasture he was to shut it off.

Mr. DICKINSON. He went in to take the water under an agreement with the other party. There must be an element of adversity between the two people. There never was an adverse use. I presume there was no written agreement. The moment "B" sold out, that put an end to the agreement, if ever there was one. I would not give much for "E's" alleged right.

Secretary STOCKWELL. I move that the meeting of the Board of Agriculture be now dissolved.

The motion was carried, and the meeting dissolved at 1.20 P.M.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE,

AT

BOSTON.

JANUARY 8 AND 9, 1901.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 8, 1901, at 11.30 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by First Vice-President Wm. R. Sessions.

Present: Messrs. F. H. Appleton, J. S. Appleton, Avery, Barrus, Barton, Benedict, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Damon, Danforth, Davis, Ellsworth, Gleason, Howard, Jewett, Kilbourn, Lloyd, Pratt, Richardson, Sargent, Sessions, Smith, Spooner, Stockwell, Thayer, Thurston, Turner and Whitmore.

The records of the public winter and special meetings of the Board were read and approved.

The executive committee, as committee on credentials, by Mr. W. A. Kilbourn, chairman, reported the list of qualified members of the Board for 1901. The newly elected members are as follows: —

At large, appointed by the Governor: —
Warren C. Jewett of Worcester.
Elected by the societies: —
Barnstable County, John Bursley of West Barnstable.
Hampshire, A. M. Lyman of Montague.
Martha's Vineyard, Johnson Whiting of West Tisbury.
Middlesex North, Joshua Clark of Tewksbury.
Oxford, W. M. Wellington of Oxford.
Spencer, John G. Avery of Spencer.
Union, Enos W. Boise of Blandford.
Worcester North-west, T. H. Goodspeed of Athol.
Worcester South, C. D. Richardson of West Brookfield.

The report of the committee was accepted and adopted.

The committee appointed at the public winter meeting to report resolutions on the death of Messrs. Grinnell and Horton, reported as follows: —

In remembrance of one not lost, but gone before, the members of the State Board of Agriculture desire to place on record their appreciation of the worth of James S. Grinnell.

A man of singularly cheerful and genial temperament, his presence was always welcome. Generous of heart and true to his friends, he never failed them in the hour of need. Wise in counsel and outspoken in its expression, his advice was never sought in vain. A lawyer by profession, engrossed for years in the exacting duties of the Patent Office, he never forgot his early training or his love for agriculture, and was always to be found in the front ranks of those striving for its best interests. Fulfilling to the letter every duty laid upon him, he never shirked an obligation, and counted it among his highest privileges to attend the meetings of this Board. Frank, loyal and warm-hearted, we mourn the man, the friend, the brother.

Another member has passed away since the last annual meeting, in whose memory the Board would record the following. Mr. D. A. Horton had been a member of the Board of Agriculture since 1889, having represented the Hampshire Agricultural Society for three years, and since has served as member at large by appointment of the Governor. He was commissioned by the Governor one of the original members of the State Dairy Bureau, and held that position at the time of his death. His service on both Boards was always prompt, efficient and able. The Board of Agriculture has lost an able and valued co-worker, the Dairy Bureau its most experienced member, and the cause of agriculture a disinterested friend and an earnest advocate.

After brief remarks by the chairman and secretary, it was

Voted, That the resolutions be adopted and spread upon the records, and that copies be sent to the families of the deceased.

The secretary presented the presiding officer with a gavel made from a piece of wood taken from the former rooms of the Board in the Commonwealth Building, for use during the meetings of the Board.

On motion of Mr. Avery, it was

Voted, That a special committee of three be appointed by the Chair to consider the matter of societies charging admission fees for entry of cattle at fairs.

The Chair appointed Messrs. Carpenter, Clark and Howard as the committee. Later in the day the committee reported inexpedient to legislate, which report was accepted.

At 12.30 the Board adjourned to 1.30 P.M.

The Board was called to order at 1.40 P.M.

An abstract of the annual report of the secretary was presented, read and accepted.

The report of the Dairy Bureau was read by the general agent, Mr. Whitaker, and was accepted.

The report of the committee on gypsy moth, insects and birds was presented at the special meeting of the Board at Worcester, Dec. 5, 1900, and was accepted and adopted at that time.

The committee on domestic animals and sanitation, by Mr. Damon, chairman, presented a written report, which was accepted.

The committee on Agricultural College and education, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted as the report of the Board to the Legislature.

The committee on forestry, roads, and roadside improvements, by General Appleton, chairman, presented a written report, which was accepted.

The committee on institutes, rules and legislation, by Mr. Sargent, chairman, presented a written report on farmers' institutes, which was accepted.

The report of the committee on experiments and station work, prepared by the chairman, Mr. Hersey, who was detained from the meeting by illness, was read by Secretaiy Stockwell and was accepted.

On motion of Mr. Gleason, it was

Voted, That a vote of thanks be sent to Mr. Hersey for his excellent report on experiments and station work, with our regrets for his illness and absence here to-day, and our hope for his speedy recovery.

An abstract of the reports of inspectors of the several fairs, prepared by direction of the committee on agricultural societies, was read by the secretary.

Voted, To accept the reports of inspectors.

The report of the librarian was read and accepted.

At 4.30 the Board adjourned to 9.30 A.M., Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President SESSIONS, at 9.50 A.M.

Present: Messrs. F. H. Appleton, J. S. Appleton, Avery, Barrus, Barton, Benedict, Boise, Bradway, Brewster, Bursley, Carpenter, Clark, Comins, Damon, Danforth, Ellsworth, Gleason, Goodspeed, Howard, Jewett, Kilbourn, Lyman, Pratt, Richardson, Sargent, Sessions, Spooner, Stockwell, Thayer, Turner, Wellington and Whiting, and retiring members Lloyd, Smith and Whitmore.

The records of the first day were read and approved.

The committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted.

Voted, That the report be printed in pamphlet form, and copies sent to the officers of the several societies.

The committee on institutes, rules and legislation, by Mr. Sargent, chairman, presented a set of amended by-laws, rules and regulations, which was accepted and adopted.

Election of officers being in order, the chairman declared His Excellency W. MURRAY CRANE president of the Board (by a by-law of the Board the Governor of the Commonwealth is *ex officio* president).

Further elections by ballot resulted as follows: —

First vice-president, Hon. WM. R. SESSIONS of Springfield.

Second vice-president, AUGUSTUS PRATT of North Middleborough.

Secretary, Hon. J. W. STOCKWELL of Sutton.

General agent of the Dairy Bureau, GEO. M. WHITAKER of Boston.

Upon accepting the office to which he had been elected, Mr. Stockwell presented to the presiding officer and former

secretary, Mr. Sessions, a gavel, and to each member of the Board a ruler, as mementoes of the former rooms of the Board in the Commonwealth Building, which had been recently torn down, the articles mentioned having been made of some of the woodwork from the old office.

Voted, That the thanks of the Board be extended to Secretary Stockwell for his thoughtful kindness to the members of the Board.

On motion of Mr. Barrus, it was

Voted, That the secretary be requested to send a gavel to ex-secretary John E. Russell, as a souvenir of his connection and association with the Board in the old Commonwealth Building.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, John Bursley of West Barnstable, Edmund Hersey of Hingham, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, J. L. Ellsworth of Worcester.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, Chas. A. Gleason of New Braintree, Henry A. Howard of Colrain, Geo. P. Carpenter of Williamstown.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, Oscar S. Thayer of Attleborough, Joshua Clark of Tewksbury, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, F. W. Sargent of Amesbury, J. M. Danforth of Lynnfield Centre, John G. Avery of Spencer, Wm. R. Sessions of Springfield.

Committee on Dairy Bureau and agricultural products: Messrs. J. L. Ellsworth of Worcester, C. D. Richardson of West Brookfield, F. W. Sargent of Amesbury, C. B. Benedict of Egremont, W. M. Wellington of Oxford, A. M. Lyman of Montague.

Committee on Agricultural College and education: Messrs. John Bursley of West Barnstable, C. K. Brewster of Worthington, Wesley B. Barton of Dalton, Alvan Barrus of Goshen, W. C. Jewett of Worcester.

Committee on experiments and station work: Messrs. Edmund Hersey of Hingham, T. H. Goodspeed of Athol, N. I. Bowditch of Framingham, S. B. Taft of Uxbridge, Wm. H. Spooner of Boston.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, J. S. Appleton of Nantucket, H. A. Turner of Norwell, O. E. Bradway of Monson, E. W. Boise of Blandford.

Committee on institutes and public meetings: Messrs. F. W. Sargent of Amesbury, Edmund Hersey of Hingham, Edward M. Thurston of Swansea, W. B. Barton of Dalton, Henry C. Comins of Northampton.

Which appointments were approved by the Board.

Election of specialists being in order, ballots were taken, and the election resulted as follows: —

Chemist, Dr. C. A. GOESSMANN of Amherst (Massachusetts Agricultural College).

Entomologist, Prof. C. H. FERNALD of Amherst (Massachusetts Agricultural College).

Botanist and pomologist, Prof. S. T. MAYNARD of Amherst (Massachusetts Agricultural College).

Veterinarian, Prof JAMES B. PAIGE of Amherst (Massachusetts Agricultural College).

Engineer, WM. WHEELER of Concord.

Ornithologist, E. H. FORBUSH of Wareham.

On motion of General Appleton, it was

Voted, That the secretary be directed to call a meeting of the committee on forestry, roads and roadside improvements, to consider and recommend a law for the better protection of wood lands and for better roadside improvement, for presentation to the proper committee of the Legislature now in session, if in their judgment such seems wise.

On motion of General Appleton, it was

Voted, That the Board authorize the publication in the next annual report of this Board of the ideas suggested yesterday for better preserving forest land and protection by the State, as offered by Vice-President Sessions.

On motion of Mr. Sargent, it was

Voted, That the present committee on the agricultural exhibit to the Pan-American Exposition be continued, with full powers to act for the Board in all matters relating thereto.

Voted, That a committee of five be appointed by the Chair to devise and prepare for suitable recognition of the fiftieth anniversary of the founding of the Board, and report to the next annual meeting, or to a special meeting if deemed best; and that the Hon. Geo. S. Boutwell be a guest of honor at that meeting, he having been the presiding officer at the first meeting.

The Chair appointed Messrs F. H. Appleton, Sessions, Kilbourn, Ellsworth and Spooner as the committee.

Voted, That the secretary of the Board be directed to visit the experiment stations and agricultural departments in the New England States, to come into closer relations with our brothers in agricultural work, to study methods of work and note results, and report to the next annual meeting.

Mr. O. S. Thayer presented and read an essay on "Better roads for Massachusetts," which was accepted.

Mr. H. C. Comins presented and read an essay on "Agricultural organizations," which was accepted.

Mr. Kilbourn, for the committee on agricultural societies, reported recommending that the date for the commencement of the fair of the Bristol County Agricultural Society be changed to the third Monday in September, that of the Worcester North-west Agricultural and Mechanical Society to the first Monday in September, and that of the Hoosac Valley Agricultural Society to the first Monday in September.

Voted, To change the dates of the commencement of the fairs of the Hoosac Valley and Worcester North-west societies, as recommended, and that the matter of change of date of the Bristol County Society be referred to the executive committee for adjudication.

Mr. Kilbourn, for the same committee, reported recommending the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 24, 25 and 26, ...	H. C. Comins.
Barnstable County, at Barnstable, August 27, 28 and 29, ...	F. W. Sargent.
Berkshire, at Pittsfield, September 10, 11 and 12,	John Bursley.
Blackstone Valley, at Uxbridge, September 10 and 11, ...	C. D. Richardson.
Bristol County, at Taunton, September 17, 18 and 19, ...	W. B. Barton.
Deerfield Valley, at Charlemont, September 12 and 13, ...	E. M. Thurston.
Eastern Hampden, at Palmer, September 17 and 18, ...	O. S. Thayer.
Essex, at Peabody, September 17, 18 and 19, .	J. L. Ellsworth.
Franklin County, at Greenfield, September 18 and 19, ...	C. B. Benedict.
Hampshire, at Amherst, September 24 and 25, .	W. H. Spooner.
Hampshire, Franklin and Hampden, at Northampton, October 2 and 3, ...	Joshua Clark.
Highland, at Middlefield, September 4 and 5, .	W. A. Kilbourn.
Hillside at Cummington, September 24 and 25, .	Geo. P. Carpenter.
Hingham at Hingham, September 24 and 25, .	T. H. Goodspeed.
Hoosac Valley, at North Adams, September 2, 3 and 4, ...	J. G. Avery.
Housatonic, at Great Barrington, September 25 and 26, ...	Q. L. Reed.
Manufacturers' Agricultural, at North Attleborough, September 10, 11 and 12, ...	Johnson Whiting.
Marshfield, at Marshfield, September 18, 19 and 20, ...	E. W. Boise.
Martha's Vineyard, at West Tisbury, September 17 and 18, ...	Alvan Barrus.
Massachusetts Horticultural, at Boston, October 1 and 2, ...	N. I. Bowditch.
Middlesex North, at Lowell, September 12, 13 and 14, ...	C. K. Brewster.
Middlesex South, at Framingham, September 17 and 18, ...	J. S. Appleton.
Nantucket, at Nantucket, August 28 and 29, .	Isaac Damon.
Oxford, at Oxford, September 5 and 6, ...	J. M. Danforth.
Plymouth County, at Bridgewater, September 11, 12 and 13, ...	C. A. Gleason.
Spencer, at Spencer, September 19 and 20, . .	A. M. Lyman.
Union, at Blandford, September 11, 12 and 13, .	W. C. Jewett.
Weymouth, at South Weymouth, September 26, 27 and 28, ...	S. B. Taft.

Worcester, at Worcester, September 3, 4 and 5, .	H. A. Howard.
Worcester East, at Clinton, September 11, 12 and 13, ...	H. A. Turner.
Worcester North-west, at Athol, September 2 and 3,.	O. E. Bradway.
Worcester South, at Sturbridge, September 12 and 13, ...	W. M. Wellington.
Worcester County West, at Barre, September 26 and 27, ...	Augustus Pratt.

The report of the committee was accepted and adopted.

At 12.40 the Board adjourned to 1.45 P.M.

The Board was called to order at 1.45 P.M.

Voted, That the doings of the executive committee, acting for the Board, the past year, be approved and adopted as the actions of the Board.

Voted, That all unfinished business or new business arising before the next regular meeting of the Board be left with the executive committee, with power to act.

Voted, That delinquencies of societies in making required returns be referred to the executive committee, with full powers.

The committee on institutes and public meetings, by Mr. Sargent, chairman, reported recommending that the next summer meeting be held at Swansea, some time in August, on invitation of Mr. Thurston; and that the next public winter meeting be held at Northampton, on invitation of the Hampshire, Franklin and Hampden Agricultural Society.

Voted, To accept the report, and to hold the meetings as recommended.

Voted, That the Chair appoint a local committee of five, to act with the secretary and the committee on institutes and public meetings, as a committee of arrangements for the public winter meeting at Northampton, Dec. 3–5, 1901.

The Chair appointed Messrs. Comins, Lyman, Sessions, Barrus and Anderson.

Mr. Sargent, for the same committee, reported recommending the appointment of Hon. Wm. R. Sessions to prepare a paper on "Massachusetts forestry," and Mr. John Bursley one on "The influence of the Board on the agriculture of the State," to be read at the next annual meeting of the Board.

Voted, To accept the report, and appoint the essayists as recommended by the committee.

The records of the second day's meeting were read and approved.

At 2.30 P.M. the meeting was dissolved.

JAMES W. STOCKWELL,
Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 9, 1901.]

The committee on agricultural societies report that they have carefully examined, and in some instances have amended, the reports of inspectors, the abstracts of which have been read to the Board. These reports indicate that the fairs of the last year have been more successful than usual in the financial results, and that there have been few objectionable features. Still, they show that the business of holding fairs is attended with considerable risk, and your committee can only urge upon the societies their duty to use great care in expending large sums of money in preparation, when there is always uncertainty of return.

They believe that, the more the neighborhood interest can be encouraged to contribute to the exhibition from their cattle and horses, swine, sheep and poultry and from their own products and handiwork, the greater will be the real success of the fair. And this local interest is the vital point, to be considered beyond any and all others, and that society is likely to be permanent and that fair is well managed, when the community about feel and say, "This is our fair," and take credit to themselves in the successful and creditable exhibition that is made, whether its strong point, as at Hillside, is in cattle, or in manufactures, as at the Middlesex North. We desire to encourage these differences, and not to make each fair a copy of every other; and, in so doing, each society will do the most good, and will be a centre of improvement and of honorable competition along lines best suited to its own neighborhood.

WILLIAM A. KILBOURN.
CHAS. A. GLEASON.
HENRY A. HOWARD.
GEO. P. CARPENTER.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Read and accepted at the Annual Meeting, Jan. 8, 1901.]

So far as it is possible to learn, the sanitary conditions of the farm buildings throughout the State have been much improved in the last few years, and, as a result, the condition of the domestic animals has also to a large extent been greatly benefited, thereby calling for less rigid inspection on the part of the Cattle Commissioners.

Your committee have no special suggestions to make in this matter.

ISAAC DAMON.
OSCAR S. THAYER.
JOSHUA CLARK.
FREDERICK L. WHITMORE.
A. W. LLOYD.

REPORT OF COMMITTEE ON EXPERIMENTS AND THE HATCH EXPERIMENT STATION.

[Read and accepted at the Annual Meeting, Jan. 8, 1901.]

Very few who have not given the subject intelligent thought realize the difficulties to be overcome while making an agricultural experiment that will secure results which are not only correct, but which will be a step of progress in agriculture, so easily understood that the farmer can apply it to his own farm in a manner to secure the full benefit of it.

In field experiments there are such variations in climate, elevation of land and natural and artificial conditions of the soil, that an experiment which might secure information that would be a step of progress when applied to one farm, would cause a step backwards when applied to another farm.

This fact confuses many who fail to understand why the experiment station does not send out a multitude of facts, clothed in language so simple that every one can understand their full meaning, though they have never learned the meaning of a single term used in describing plant food or plant growth.

The experiment station rarely gets the full credit it is entitled to. For example, information is sent out that Paris green will kill insects when applied diluted with water, giving the amount of poison to be mixed with a given quantity of water. Some one, who thinks he knows quite as much as the professors of the station, finding he can save a few dollars by using the poison in a dry form, purchases a shooter and applies the Paris green in a dry form, and, to make sure to kill all of the insects, he applies enough to kill the leaves of the plants and hundreds of dollars' worth of fruit. Or the station sends out a statement that arsenate of lead will kill insects, and gives the exact formula for mixing,

but those who jump at conclusions and mix wrong, apply it to the crop, and destroy both leaf and fruit. Who is to blame for this? Certainly not the officers of the station; they are not supposed to furnish the brain power to the farmers, and to those who are not farmers and never will be.

But a better day has come, — the farmers of Massachusetts during the past few years have made rapid progress towards a better understanding of the terms relating to feeding both plants and animals, and are beginning to realize the importance of this knowledge, if they would reap the full benefit of the experiment station.

The Massachusetts Agricultural College and the agricultural department of Harvard University are educating considerable numbers of intelligent young men in those lines which relate to the best methods of farm work. These young men, when educated, go to their homes and for a time mingle with the farmers of their native towns, and some of them have taken their fathers' farms and run them to a larger profit than their fathers were able to, thus proving to the whole community that their education is worth more than a lifetime of practice.

The time is not far distant when the farmers will realize that to make a success in farming it is just as important that the young man should receive an education especially adapted to his occupation, as should the clergyman and the physician. When this day comes, our experiment station will receive full credit for the work it does; but to-day there is not a single department that gets but a small portion of the credit which honestly belongs to it.

If we should blot out all that the department of chemistry has done, we should be amazed at the results. The farmers would be cut off from all help as to the value of any fertilizer or the condition of any water that might be thought to be unhealthy, unless they expended what to them would be large sums for a special analysis.

Blot out all the work that has been done by the department of entomology and destroy all of the information sent out, and the result would be the destruction in a few years of millions of dollars' worth of the farmers' crops; and the same would be true of some of the other departments.

The agricultural department is doing important work, which in time will bring out new and valuable facts. To establish facts relating to the cheapest and best methods of feeding both plants and animals requires time and careful work, as well as high intelligence. No doubt information of great value to the farmer will be secured by continuing the experiments now in progress in this department, but the farmers must be patient, and not overlook the fact that many of the experiments tried must necessarily prove failures, except to teach how not to do, and that the few which promise to secure important steps of progress in agriculture should not be recommended to the public until their value has been fully proved by several years of trial, under conditions as varied as they would be likely to meet under the directions of the farmer.

Your committee found every department of the station in excellent order, and the work is evidently being done in a faithful manner, directed by high intelligence.

If the members of the Board of Agriculture would visit the station more frequently, and make themselves familiar with the important work that is being done in every department, they would be better prepared to convince the farmer that the station, in a money point of view, is a great benefit to the State; and that, if he will put himself in communication with it, it will be a great benefit to him as an individual. The money which it has cost to run the station since it was established is very small, when compared with the money it has saved by sending out information relating to the best methods of destroying insects and fungi, and how best to feed plants and animals.

It is to be regretted that an institution so profitable to the State should not have for its use money sufficient to secure the undivided attention of the professors who are at the head of each department. It may be said that it is very easy to select a few experiments to be tried, and place them in charge of an assistant; but a thoughtful man realizes a serious difficulty at the outset. An ordinary man, while digging post holes or potatoes, may think of a hundred experiments to be tried; while a thoughtful man, who has had experience in the business, would be likely to think of five hundred experi-

ments, which ought eventually to be tried; and, as he may not be prepared to enter upon the trial of more than ten each year, if he is to do the best possible work, he will not select the first ten experiments that present themselves to his mind when confused by a multitude of duties, many of them but slightly connected with this line of work; but, realizing the importance of the work, if his mind is not distracted by other duties, he will give it his full, individual attention, until by thorough investigation he feels reasonably sure that he has selected the ten experiments that are the most important to be tried first, though it may take months of research and thought. If he does not do this, but takes the first ten that present themselves to his diversified mind, it may be fifty years before he comes to the other ten experiments that ought to be tried first.

EDMUND HERSEY,
Chairman.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 8, 1901.]

The greatest obstacle and discouragement to the application of true forestry to our wood, sprout, untillable and non-pasture lands is probably forest fire. This scourge is known to most parts of the State in varying degree, but the fair face of Massachusetts has been most severely scarred on her unique Cape district. It is Massachusetts as a whole that our Board has to deal with; and good principles, that can be applicable to the most needy part, will be of value to the more densely peopled.

Recently reading in a promotive publication, "The Forester," of experiences with forest fires in the State of Pennsylvania, our State laws to aid in combating the causes of such fires were stated to be good, and preventive, so far as law can aid. Pennsylvania, with her great commercial interests in "using and preserving" her forests, should be a good judge, and her leading forester, Professor Rothrock, is well able to speak wisely as to how far laws can be useful.

Our Cape district is a unique feature in our nation, and there is profit to our State in giving to it the best thought possible. I cannot speak with detailed expert knowledge of the characteristics of that large tract of townships bordered by the salt waters, and with an attractive climate that is peculiar to itself. But I do know that, unless its reputation for frequent and destructive forest conflagrations greatly ceases, the benefits that rightfully belong there must be far less than the Cape district deserves.

What can this Board do to guard the State's interest there? An association of representatives from the several towns and villages comprising the territory in question should be able to decide, after associating themselves with the best possible

expert knowledge, what, if anything more, can be done than is being done at the present time. We seem to have no appropriation of money with which to act in this matter, so that we need not take up time in considering possible action on such lines. Possibly we could institute the formation of a convention somewhere in that district, upon the lines I have suggested, to be addressed, under this Board's auspices, by experts and local representative men, the result of which convention would be action, or non-action, as would seem to those assembled wisest for the preservation and promotion of possibilities which belong to one of the most interesting and unique tracts of land in Massachusetts and this nation. If good came out of such action, it would be to the credit of this Board, and be a guide to action elsewhere.

To protect large tracts, or small tracts, a division by road ways is most helpful; and, the more those ways can become popular for driving and teaming, so much better the protection.

It has been proposed, before the Legislature of a previous year, that the proper State authorities be authorized to purchase, in the name of the State, at a price perhaps not exceeding three dollars an acre, forest, stump or waste lands, on the Cape, for example, and for the State to issue bonds to pay for the same; such lands to be divided into sections, by roads of simple construction, that shall allow of the passage of foresters' wagons, other vehicles or persons on horseback. The idea has been advanced that, by judicious action, the State would thus in due course of time possess a valuable property, and do a great preventive work against the present scourge of forest fires.

We have a tree warden law that is under trial, and time will prove its value and show its weak points, if the latter exist.

I am cognizant of the fact that officers of wire departments, with large corporate interests, have lately sought advice, and publications, that would instruct their superintendents in best methods of pruning roadside trees. This is certainly a good evidence that results, for which this committee exists, are being realized, and with harmony.

Our system of road building has advanced much, as time has made such possible, and as our people have learned what is better and appreciate it, when their superintendents of streets put in practice the best methods that the amount of the appropriations allow.

I shall not attempt to speak further and in more varied ways at the present time. I have endeavored to make one special point prominent, and that is "forest fires," and their great injuries to Massachusetts interests.

I make the following suggestion, after consultation with others of the Board, in order that a present legislative requirement of long standing may be so broadened as to include more present interests, — that section 8 of chapter 114 of the Public Statutes be amended by inserting after the word "ship," in the last line, the words "and other," so that it shall read "ship and other timber." I make this suggestion, hoping to have the proposed amendment brought before the Legislature of 1901.

FRANCIS H. APPLETON,
Chairman.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[P. S. Chap. 20, Sect. 5, adopted by the Board, Jan. 8, 1901.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

Your committee, having completed the duties assigned them by occasional visits to the college, and a general inspection of the work, from time to time, at different seasons of the year, beg leave to report as follows: —

The "Grinnell prizes," which are awarded by this committee, based upon written essays and oral examinations of the graduating class in agriculture, were awarded in June, 1900, as follows: the first prize was awarded to Mark H. Munson of Huntington; the second to Morris B. Landers of Palmer. The oral examinations were well sustained; the essays were thoughtfully prepared, but with too little attention to minor details.

To lay aside, now and then, the philosophy of nitrogen, phosphoric acid and potash, of clover nodules and fungi, to study the potency of semicolons and interrogation points and the art of syntax and orthography, might be helpful even to college graduates.

The Farm.

The usual farm work, with its practical and experimental operations, has been carried on successfully, although natural conditions have operated in some cases to lessen results. The testing of seeds, fertilizers and chemicals, here made in a scientific way, of the results of different foods and rations to attain certain results, are being given to the farming public at institutes and in various ways, to awaken new interest

and meet the changing conditions of the farm and of the farmers.

The committee, recognizing this as the true "Mecca" of progressive farming in Massachusetts and the "ideal storehouse" of exhibit as well as scientific instruction, would like to see an improvement in the neat stock of the institution. The Massachusetts Agricultural College falls short of its high purpose, if it does not, for use and exhibit, have typical herds for milk, butter and beef.

Class Work.

Wide-awake men are utilizing more and more the by-products of nature, as well as of manufactures. Special work in the line of extensive intensive farming calls for science in agriculture. Science and practice must go hand in hand in the future, to a large extent, to attain success in farming. This is what the college is fitting men for. New methods are constantly coming to the front; new problems are constantly arising; new obstacles appear. All have to be met, mastered and overcome. It all falls back upon the man. A well-trained mind can always guide a cunning hand, and meet the changes.

In addition to regular work, short winter courses in agriculture are given, without examination or tuition. The objects are: (1) to present in a practical way the results of scientific investigation in agriculture; (2) to help students to be better dairy farmers, creamery managers, fruit growers, market gardeners and farm superintendents; (3) to make the students better acquainted with the Agricultural College and experiment station; (4) to help establish habits of reading, study and thought.

Entomological Department.

This department, while it deals with small things, is not so conspicuous to the casual observer as some other departments, yet it is of great value and of utmost importance.

The question of dealing effectively with injurious insects and fungi has become one of profit or loss with every fruit grower, horticulturist and market gardener. It is estimated that the annual loss caused by insects in the United States

is three hundred million dollars. To meet this obstacle in the way requires thorough work and study in the line of entomology. We believe this department is managed with consummate skill and ability.

The New Veterinary Department.

The veterinary department, with its well-appointed class rooms, experimental outfits and laboratory equipments, is an important adjunct to the institution, and will doubtless prove of great benefit to stock raisers and farming interests in disseminating new light and knowledge in dealing with animal diseases, and fitting men to treat them successfully.

The Military Department.

The death of Captain Dickinson of the college, and the removal to other fields of duty of his successor, paralyzed for a time the work of this department; but under the efficient management of Capt. John Anderson, who has been assigned to duty here, a new spirit and interest have been revived, and the thorough military drill is not only a pleasant feature to those who visit the college, but of invaluable worth to students, in the line of order, discipline and physical benefits. The college now has a fine military company.

The Experiment Station.

The work here has been carried forward, under its very efficient director, in the usual courses, bearing particularly upon conditions of health as influenced by water supplies, testing of fertilizers, seeds, soils, etc., and a variety of experiments which are given to the public by way of bulletins.

This is a department of investigation, and more difficult to the superficial observer, to understand, in scope, condition and value, than others. That it ranks among the first in the country in scientific ability and attainments is the concensus of opinion of all who come in contact with its work.

Horticultural Department.

In this department new varieties of fruits are being tested for their characteristics and worth, so that farming communities may know which are most desirable to grow for market

use. Crops are sprayed, to protect them from insects and fungous pests, with system and exactness, and close records made of the results. New insecticides are carefully tested, and results compared with those of standard formulas. New packages for the keeping and shipping of fruit are being tested, and many other investigations in new lines are being prosecuted, which will be of great benefit to horticultural interests in the future. The patient labor, the watching and waiting required in this department to secure the desired results, in the efforts which may mean a thousand failures to one success, can be readily understood, when we remember how many wild and worthless apples were grown before our best varieties attained their present excellence. The same is true of all fruit, flower, vegetable, plant and tree growth. Taken together, there are very many failures to one success. We can count on our fingers the really desirable varieties of strawberries, blackberries, raspberries, cherries, plums, peaches, pears and apples there are in the markets of to-day. The same fact is apparent in every department of life, getting the best at infinite expense and labor; yet who would leave the new and accept the old, even at its minimum cost?

Future Work and Support.

The matter of restoring depleted forests, of renewing exhausted soils, of a more prompt and efficient mail service, of better and quicker facilities from farm to market and from market to farm, of better roads and improved highways, how to meet western competition in products and prices, of enhancing the social and pecuniary condition of farming communities, are problems which must be met and demonstrated in the near future for New England farming communities and interests. Men must be trained to lead the work in various callings, as the times and changed conditions demand.

We believe the people of Massachusetts as a whole, and by their constitutional organizations, should give not only a liberal but an enthusiastic support to this institution, which is closely in touch with her sanitary, commercial, social and educational interests.

The college, with its manifest advantages, in our judgment needs a more thorough and aggressive system of advertising

in the common avenues of newspapers and periodicals that reach the firesides and homes of rural communities, with the same push and spirit that appear in the active business enterprises of the day, insomuch as to largely increase the patronage of the institution and give greater results for the outlay.

At a meeting of the Alumni Association, held in June, 1900, at Amherst, a committee was appointed to consider the matter of advertising the college more effectually. This committee, with the aid of heads of different departments of the college and the editors of "Aggie Life," have issued a very clear and concise statement of the course now offered. A thorough perusal and distribution of this publication may well interest the members of this Board.

JOHN BURSLEY.
C. K. BREWSTER.
WESLEY B. BARTON.
GEO. P. SMITH.
ALVAN BARRUS.

REPORT OF COMMITTEE ON INSTITUTES, RULES AND LEGISLATION.

[Read and accepted at the Annual Meeting, Jan. 8, 1901.]

The committee, sitting as a committee on farmers' institutes, held a meeting in November, 1900, at which the list of institute speakers was discussed, and its publication in the form in which it appeared on Dec. 17, 1900, authorized.

The system of the holding of farmers' institutes in this State was discussed, and the committee believes that it is generally well adapted to the needs of the farmers of the State.

The attendance, averaging over 90 per institute during the season, is a valuable index to the interest taken in these meetings by the farmers and the good accomplished by them. That there are many localities, however, where these institute meetings do not receive the attention they deserve, cannot be gainsaid; and the committee has thought it desirable to include in this report a summary of the attendance at the institutes held by the various societies, so that those which are doing good work along this line may receive due credit, and those where the attendance and interest are not what they should be may be spurred on to give more attention to them. The attendance at the meetings held in 1900 was as follows: —

Amesbury, 127, 90, 62, 80.
Barnstable County, 30, 100, 70.
Berkshire, 19, 60, 15.
Blackstone Valley, 15 for one and no report for the other two.
Bristol County, 55, 70, 50.
Deerfield Valley, 200, 50, 25.
Eastern Hampden, 100, 35, 125.
Essex, 95, 120, 120.
Franklin County, 75, 60, 35.
Hampshire, 60, 50, 100.
Hampshire, Franklin and Hampden, 75, 50. 100, 80.
Hingham, 12, 13, 75, 28, 37.
Highland, 26, 50, 120, 72.
Hillside, 100, 200, 75, 75.
Hoosac Valley, 15, 19, 15.
Housatonic, 25, 25, 50.
Manufacturers', 200, 100, 20.
Marshfield, 70, 20, 75.

Martha's Vineyard, 25, 150, 25.
Massachusetts Horticultural, 90, 200, 500, 150, 300, 300, 175, 200, 200, 100.
Middlesex North, 150, 150, 250, 250.
Middlesex South, 75, 60, 50.
Nantucket, 25, 20, 10, 10.
Oxford, 30, 350, 25.
Plymouth County, 60, 50, 60, 30.
Spencer, 45, 85, 40.
Union, 140, 160, 175.
Weymouth, 17, 12, 40.
Worcester, 200, 150, 300.
Worcester East, 52, 35, 21.
Worcester North-west, 200, 35, 135.
Worcester South, 40, 85, 68.
Worcester County West, 50, 50, 50.
Worcester North, 200, 175, 150, 125.

While your committee realizes that there may be many circumstances which may cut down the attendance at these meetings at times, and that often criticism may be unjust, still, it cannot but feel that a society where the attendance habitually falls below 50 does not take the proper interest in the work, and is not making the use of its opportunities which the State has a right to expect.

F. W. SARGENT.
E. M. THURSTON.
WESLEY B. BARTON.
H. C. COMINS.

REPORT OF THE LIBRARIAN.

[Adopted at the Annual Meeting, Jan. 8, 1901.]

To the Secretary of the Board of Agriculture.

SIR: — The fourth report of the librarian is herewith presented.

In accordance with the instructions of the Board, the unbound copies of the library catalogue have been bound. Copies have quite generally been placed in near-by public libraries; libraries of educational institutions have also been supplied. The edition was 500 copies, and 150 remain undistributed.

The librarian's suggestion of last year, that "books borrowed from the library of the Board must be receipted for and returned within one month," having been adopted, the plan of loaning books to responsible parties has been in force the past year, and 46 books have been so loaned.

It is interesting to notice that works on forestry and arboriculture have been those most in demand, 9 in all. Six works on entomology and 6 on cattle were loaned, 4 on landscape gardening, 4 on flowers, 3 on farm implements and machinery, 2 on birds, 2 on tuberculosis and 1 each on market gardening, spraying, botany, horticulture, zoölogy, goats, beet sugar, farm engineering, statistics, and a scientific report.

Back volumes of the "Agriculture of Massachusetts" have been supplied on call, as in past years, to institutions and to individuals. The institutions receiving the largest number of volumes were the Ohio Department of Agriculture, Columbia University, Syracuse University and the University of California.

The library now has 20,600 index cards to experiment station literature, 534 to the publications of the United

States Department of Agriculture and 1,153 to the general office library.

One hundred and twelve bound volumes have been added to the library since the catalogue was issued, the number of bound volumes Jan. 1, 1901, being 3,293.

The expenses incurred on account of the library the past year were as follows: binding catalogues, \$50; books and pamphlets purchased, \$43.36; current publications subscribed for, \$34; binding, \$11.75; supplies, \$10.75; total, \$149.86. These expenses were paid from the appropriation for "incidental expenses in the office of the secretary."

Respectfully submitted,

F. H. FOWLER,

Librarian.

REPORT OF DELEGATES TO THE FARMERS' NATIONAL CONGRESS.

COLORADO SPRINGS, COL., AUG. 21–31, 1900.

Hon. J. W. STOCKWELL, *Secretary Massachusetts Board of Agriculture.*

SIR: — The delegates from Massachusetts in attendance were John G. Avery, H. P. Howland and A. F. Jones of Spencer, Ethan Brooks of West Springfield, George M. Whitaker and Ella A. Dolliver of Boston, and R. G. F. Candage and Sallie C. Candage of Brookline.

The Congress met in the auditorium of the high school building, Colorado Springs, Aug. 21, 1900, at 10 o'clock A.M., and was called to order by the president, R. G. F. Candage of Massachusetts. In all there were some five hundred and fifty delegates and associates present.

Rev. Wm. H. Fish of All Souls Church, formerly of Dedham, Mass., opened the Congress with prayer.

Mr. Gilbert McClurg, secretary of the Chamber of Commerce, Colorado Springs, welcomed the Congress on behalf of that organization. Mayor J. S. Robinson of Colorado Springs followed with an address of welcome of a cordial character, in which he said: —

The cordiality of your welcome is increased by the fact that most of us claim a real or honorary membership in the great fraternity you represent. Most of us were fortunate enough to have had a rural nativity, and by many ties are still rooted to the soil; and your presence here to-day recalls the past, and we sense the fragrance of clover and apple blossoms, hear again the low of cows, the bleat of lambs, the minstrelsy of woods and fields and the rustle of bladed corn stirred by the breezes of golden autumn.

It is a fact, and one of vital significance to our country, that the farms are the manufactories of the best product of American brain and brawn, of American character and manhood. Three-fourths of the youths in our higher schools of

learning come from the farms and rural communities. It is true also of a majority of the men who lead in public affairs, that they were born and reared in the country.

The farms, too, are schools of patriotism. The boy whose ductile foot has clung to the soil of his father's farm will grow into a lover and defender of his country. The man who looks upon his home and fields, feels a joy of ownership and sense of freedom, becomes, when the hour demands and duty calls, a Cincinnatus or an Israel Putnam, and leaps from the furrow to the ranks of his country's defenders, — drops the plow handle and seizes the sword in defence of his fireside and his country.

The character of the citizens and the greatness of the industry you represent makes this Congress of farmers of great and national importance, and what you do here will redound to the betterment of every national interest. We hope, as you look upon these grand and enduring mountains, as you cross and recross the great States and Territories that make up our matchless domain, as you meet here as fellow workers from all sections of the United States, you will gain new faith in the permanence of our institutions, realize more fully the vastness and richness of our national resources, see with clearer vision than ever before the unity of purpose that binds together and inspires to patriotic and noble achievements the people of every section of our beloved country.

The president then presented Gov. C. S. Thomas of Colorado, who said, in part: —

It is a truly interesting thought, when we realize that the session of the Farmers' National Congress that is now opening is being held here in the shadow of the mountains, on the extreme western edge of the vast tract of land which for so many years, and even for generations, was known as the Great American Desert. You have come here by traversing a wide region that was once barren. To reach the shade of these beautiful trees and of the historic mountains near at hand, you have crossed a region where improved methods of farming have had their effect. You have come to discuss methods and plans whereby you may further improve on the methods by which you have wiped out the Great American Desert, not only from the map, but from the face of the earth.

In a few short years the domain of agriculture has been extended even to the western seaboard, and the waste places of the land have become the garden spots and the granary of the world.

It was the love of gold and the search for it that brought men out into this western country. The Pike's Peak excitement of 1859 and the rush of people to Montana and Idaho started the population of this section of country. But it was the farmers who remained who developed the resources and made them what they are to-day. They took a waste tract of land, and it has become an empire.

While Colorado is rich in mineral resources, and produces more gold than any other State in the Union, still, all her mineral wealth is insignificant compared with what farmers have done for the wealth of the country, even in a single year, and insignificant as compared with the resources of agriculture in Colorado, which are as yet practically untouched.

Responses were made by Secretary Stahl, Col. B. F. Clayton and President Worst of the North Dakota Agricultural College.

At the afternoon session President Candage of Massachusetts delivered his annual address, brief abstracts of which are here given: —

You are assembled here from your respective abodes in the several States and Territories of our broad land, to open, and, by your deliberations, discussions and resolutions upon agriculture and other topics connected with the farming interests of our great resourceful country, to conduct, the twentieth annual session of this Congress. You are happily met in a place of great natural beauty and grandeur in the centennial State, — a State of vast agricultural and mineral resources, situated "in the midst of the everlasting hills," the grandest and highest mountain range of our continent, from which you may draw inspiration to make this session of our Congress one of lofty ideals.

In a survey of the world's great agricultural field, the prospect for the present and the future is centred on this continent, as giving the promise of the best return to the tiller of the soil to be found anywhere on our globe. Here great droughts, bringing famine and pestilence in their train, are unknown,

and devastating wars are not likely ever again to occur to hinder the work of the husbandman; but with a stable government, a rich yielding soil, an increasing population, better paid labor than elsewhere, a steady market is secured for the products of the farm, and demands from abroad, at remunerative prices, take any surplus that may remain over.

In importance, magnitude and value, the products of the soil represented by the delegates to this Congress overshadow all other interests making for the comfort, happiness and well-being of our country and its people.

Transportation is of vital importance to the farmer, and the development of interior portions of our country in agricultural and other products. With the introduction of railroads, the country's progress in population, wealth and resources has been a marvel. Without their aid, farm and crop beyond home consumption would be worthless; with their aid, both are valuable. In this connection, river and harbor improvements by the general government are of interest to the farmer for they tend to lower the cost of transportation by competition with the railroads.

The time has come for the farmers, manufacturers and commercial men to unite, and demand from our national government an American mail service to South America, and to other foreign countries, in steamships under our own flag. It is well known that trade follows the flag of the nation which floats and upholds it. South American countries are our neighbors and natural allies in trade and commerce, and yet, for lack of direct mail and shipping facilities, Europeans supply them with the bulk of their imported commodities.

An American merchant marine, which is needed by every industry of our country for the extension of our foreign markets and as an aid to our navy, should be urged by this Congress upon the consideration of the United States Congress. No country like ours, with an extensive sea coast, with extensive exports and imports, can expect to continue prosperous without an efficient merchant marine. There is too great a drain upon our financial resources without it.

And there should be a canal constructed and controlled by the United States to connect the Atlantic and Pacific oceans,

for the benefit of our commerce in time of peace and for the benefit of our navy in time of war.

It is essential, under our form of government, where rulers are chosen from the people to make and administer the laws, that the people should be educated, and therefore we cannot too highly appreciate educational advantages. But, as education is many-sided, broad and technical, no one person can expect to master all its branches in detail, but should make an effort to master that particular branch which has to do with his life work, whether it be commerce, banking, farming, manufacturing, mining or learned profession. As the business of farming is so extensive, occupies such a large percentage of our population, and all classes are dependent upon it, a better knowledge of it should be had by those engaged therein.

Taxation is a subject of interest not only to the farmer, but to every property holder of our country, but to the farmer especially, as his property lies where it can be seen and where there is no escape, although he may believe and know that he is paying more than his just proportion. Our fathers, in enacting laws for the regulation of a just system of taxation, recognized the principle and laid down the rule "that all men should be assessed and contribute to the common charges, in accordance with their ability." And Adam Smith, a hundred years later, in his "Wealth of Nations," asserted the principle that "the subjects of every State ought to contribute toward the support of its government, as nearly as possible in proportion to the revenue which they respectively enjoy under the protection of the State." If these rules, simple and just, were carried out, there would be no cause for complaint by any one, and there would be no place for "the tax dodger" in our land. Those rules simply mean that property should pay its proportion of taxation without regard to the form of investment.

In the early settlement of our country all men were farmers, and depended upon the soil for their subsistence. They were industrious and frugal. They subdued the forest, cleared the land, and planted their seed with a sublime faith in an over-ruling Providence that the work of their hands would prosper. In the same faith they established

civil government and enacted laws for its stability, most of which we at this time recognize to have been wise and beneficial. The farmers were the law makers; they were members of the legislative assemblies, of the governor's councils and of the judicial courts; and they performed their duties with an ability and conscientiousness that reflect great credit upon their official conduct.

The farmer's patriotism, bravery and willingness to take up arms in defence of his country are unquestioned, and yet his chosen occupation is one necessarily of peace. His interests and prosperity are best served when peace reigns, and grim-visaged war hinders not a fair exchange of the products of the soil and commerce. Such being the case, why should he not join his efforts to those who seek to despoil war of its devastating influences and bloody horrors, by leaving to arbitration all questions arising between Christian nations not involving national honor, and thereby hasten the time when "swords shall be beaten into plow-shares, and spears into pruning-hooks," and "nation shall not lift up sword against nation, and neither shall learn war any more."

An able address was delivered by F. A. Converse of Buffalo, N. Y., on "Why efforts of the farmer should be directed to an intelligent cheapening of production."

The evening session was well attended. The essayist was Hon. Alexander R. Smith of New York, and his subject, "Our shipping interests." Prof. Elwood Mead of Cheyenne, head of the irrigation department of the United States, gave an address on "Irrigation investigations."

On the second day, Hon. J. B. Killebrew of Tennessee read a paper on "Natural resources of the south." Mr. George M. Whitaker of Massachusetts read a paper on "Dairying." Mr. R. W. Tansill of Pecos Valley, N. M., addressed the Congress on the resources of New Mexico. Mr. A. J. Lockridge of Indiana read a paper on "The mission of the farmer," and Mr. J. A. Springer of Colorado gave a talk on the "Value and importance of the live stock interests of the west." Mr. J. P. Brown of Indiana read a paper on the "Relation of forestry to agriculture," followed by Mr. Ethan Brooks of Massachusetts, with an address on "Agriculture as a branch of public education."

The session of the third day opened with the introduction of resolutions and routine business, after which Senor José Romero, of the Mexican embassy at Washington, was introduced, and read a paper on "General agriculture in Mexico." Mr. John E. Alter of Indiana made a humorous speech, a characterization of the speakers, from the president down to himself, in his improvised Dutch-English, which could only be fully appreciated by hearing it. Capt. Wm. W. Bates of Denver addressed the Congress on "American shipping," advocating its rehabilitation by enactment of differential duties. Mr. H. W. Campbell of Nebraska read a paper on "The redemption of the arid west." Miss Emma C. Sickles of Chicago, of the committee on domestic economy, made a report, which was accepted. The committees on the president's address, credentials, finance and on resolutions made reports, which were accepted.

The report of the special committee on revision of the constitution was read and adopted, and the Congress adjourned to Aug. 30, 1900, at 9 A.M., at which time it met, completed its business and adjourned *sine die.*

The resolutions presented and adopted at the Congress that might very properly be referred to in this report were: —

That the Farmers' National Congress, in its annual session, assembled at Colorado Springs, Col., August, 1900, urges upon the United States Congress the necessity of liberal appropriations for all meritorious, important and needed improvements of rivers and harbors, already begun, that the same may be carried forward to completion with becoming expedition, in the interest of a more extended commerce and as a safeguard against loss of life and property.

That the Farmers' National Congress calls to the attention of the United States government, and presses upon it, the necessity of establishing a speedy and direct mail service, in steamships under the American flag, between our country, Brazil, Argentina and other foreign countries, that we may thereby fairly share in their trade and commerce, and extend our exports to markets which would prove of advantage to both buyer and seller.

That the Farmers' National Congress deems it to be of great importance that a connection by water be made between

the eastern and western shores of our country, by a canal uniting the two oceans at Nicaragua, or such other point deemed most advisable, to be constructed, controlled and maintained by the United States, and urges the Congress of the United States to take such action as shall promote this object.

That the Farmers' National Congress endorses the Grout bill, now pending before Congress, especially section 1, as of exceptional importance, and that it should become a law, though nothing else were coupled with it, as it would make imitation butter subject to the laws of any State into which it might be carried.

That, with the above a national law, we favor section 2 of the Grout bill, which would increase the tax on the imitation of yellow butter, adding, however, no additional burden on oleomargarine, which may be in such distinct form and color as will apprise the consumer of its real nature.

That, in our opinion, it is the duty of Congress, at the earliest day possible, to enact legislation to secure the restoration of American-built mail carriers and freighters, by the extension of such aid as shall enable them to successfully compete with the merchant ships of foreign nations, receiving like aid, in the carrying of our exports and imports.

That we cordially commend Secretary of Agriculture Wilson for the care and pains he is exercising in the collection of seeds for distribution, and we recommend that hereafter seeds be distributed through the experiment stations, instead of through members of Congress.

That the Farmers' National Congress heartily endorses the action of the national government in extending the benefits of free mail delivery to the farmers of the country.

That we denounce all proposed leasing of the public domain for grazing purposes as un-American, and contrary to the interest and development of our country, and earnestly protest against the enactment of any national law for leasing the public domain.

That this Farmers' National Congress recommends such legislation by the States and nation as shall limit the rates on sleeping-cars to a just and fair compensation for the service rendered.

That the value of the irrigated farm and the security of the home thereon erected are dependent upon public control of the water supply and the prevention of water becoming a speculative commodity.

That the water of all streams should forever remain public property, and that the right to its use should inhere, not in the individual or the ditch, but in the land reclaimed.

That we urge the adoption of a system of harmonious irrigation laws in all arid and semi-arid States and Territories, under which the right to use the water for irrigation shall rest in the user and become appurtenant to the land irrigated, and beneficial use be the measure of the right.

That we commend the investigation of the problems of irrigated agriculture and the efforts to promote its success now being made by the Office of Experiment Stations, United States Department of Agriculture, and favor liberal appropriations for their continuance.

That the Farmers' National Congress, assembled at Colorado Springs, reaffirms the action taken by it at Boston in 1899, viz., that as agriculturists we use our best endeavors to make the Pan-American Exposition, to be held at Buffalo, N. Y., 1901, fully illustrative of the resources of every Commonwealth in the United States, and that we co-operate with the various officials of the exposition to make it the success the great undertaking deserves.

That Congress should clothe the Interstate Commerce Commission with power to enforce the decisions of said commission.

R. G. F. CANDAGE,
For the Delegates.

BOSTON, Dec. 20, 1900.

BETTER ROADS FOR MASSACHUSETTS.

BY OSCAR S. THAYER OF ATTLEBOROUGH.

The subject of better roads for Massachusetts is one of vital importance to the welfare of the State and to the prosperity of her citizens, especially in the rural districts, where they are still pursuing the methods of fifty years ago in the care and construction of their roads. In the past twenty-five years rapid progress has been made in our manufacturing, in our railroad accommodations, in our schools and colleges. To-day electricity has spread its network of rails all over the State; and, could our forefathers of even twenty-five years ago return and see the electric car, the automobile and the bicycle on our common roads, they would think indeed that they had waked up in some foreign country.

All these things demand better roads. We must adopt modern methods of building them and in caring for them. Take the management of our highways out of politics, and place it in the hands of men educated to the business. No other department in the State has been so badly abused as the department of highways, in some of the outlying districts, where the management is, in too many cases, in the hands of men who are working politics for a living, and are spending thousands of dollars annually on our highways, without knowing the first principles of modern road building. When we take up the teaching of agriculture in our common schools, I hope that we may have one department devoted to instruction in modern road building. Good roads bring prosperity, and prosperity brings good roads; they go hand in hand, each assisting the other. A recent writer has said that Spain would not have lost Cuba if she had joined the good roads movement. Far-fetched as the assertion may seem, it contains the element of truth. In spite of a long Spanish sovereignty, the common highways of Cuba — most

fertile island of the Atlantic — are still of the most wretched description. Barbaric Spain has not yet learned what Rome knew one thousand years ago, what America well knows to-day, — that roads are the arteries of commerce, along which flow the life streams of a nation, bearing success, civilization and contentment to the inhabitants.

One of the first principles of better roads is good drainage. Take the water out, and keep it out, is a rule which must be followed in the making of every road. We have to-day in some of the rural towns roads that are the lowest in the centre, and which are nearly impassable after every heavy rain. These roads must be rounded up in the centre, so as to shed the water quickly to the side drains. These drains must have a good fall to a clear outlet, and be in every respect capable of carrying off the water. Ruts and holes must not be permitted to form, but must be filled up as soon as they appear. No one thing at so small expense can be done to our roads for their improvement as drainage.

In some of the towns of the State the roads are in worse condition to-day than they were twenty-five years ago. In that time smart, hustling manufacturing villages have sprung up. Consequently, all the money that could be raised in a town was used in developing the village streets and sidewalks, leaving the outlying districts with hardly a cent for their roads, although during this time, the taxes may have nearly doubled in amount.

The time is past and gone for the continuation of the dirt roads, — one of the most expensive methods ever used in the construction of good roads. In many of our outlying districts there is an abundance of stone that should be used for making permanent roads. By the use of this stone there would be at the same time an improvement of the farms, by getting rid of what had only been a detriment to them. Upon almost every farm, in some localities in the State, may be found thousands of loads of stone, heaped up in corners of the fields, which have been accumulating for years, which should be used in making the best roads under the sun. Also, on many of the roadsides stone has been accumulating for years, as they have been raked from the road and left there, — a blot and disgrace to roadside improvement.

The town of Easton leads all other towns in eastern Massachusetts in her good roads. She has for several years adopted the stone road, and many miles of roads in her outlying districts were built of common field stones, with the aid of one yoke of oxen and an iron roller. The farmers of Canandaigua, N. Y., have been actively building stone roads for several years, and have now nearly all of the principal roads of the township improved in a most substantial manner. The roads are made entirely from the field stones of the farms along the roads, and are paid for by direct taxation. The village of Canandaigua has joined willingly in voting for the increased tax, and the farmers have carefully expended the money, so that these roads have cost less than one thousand dollars per mile. I believe these methods should be adopted in eastern Massachusetts in all her rural districts. Make the width of the road according to the amount to be expended per mile. It has been found that a road eight feet wide, made of stone, has done very good service in sparsely settled communities and at a very moderate expense.

Then, again, I believe we should adopt the methods of some of the older countries, in having path masters to have the roads in charge continually. In the older countries they have a path master with from three to five miles of road in his charge, with a small amount of money to be expended on any repairs that may be needed. It seems to me that in no place will the old adage apply more thoroughly, that a stitch in time saves nine, than in road repairs; for it is a well-known fact that a small hole allowed to remain in a road is continually growing larger, until the expense of repairing is ten times greater than it would have been at the start. Then, too, I believe a good man in charge of roads should be continued in office for a term of years. It is impossible to carry along a system of improvements successfully by continually changing the management.

One very important feature in the improvement of our highways is the care of the roadsides, which in the past have had very little care, and have been used principally as dumping grounds for all refuse material. In some localities the brush and trees have been allowed to grow until a perfect hedge hides from view the surrounding fields. Not only

should the brush and weeds be removed from the roadside, but grass should be sown, trees planted and a sidewalk prepared for the use of pedestrians. Country roads can be made far more useful and attractive than they usually are, with very little expense. Although such improvements are not necessary, yet they make the surroundings attractive and inviting, and add to the value of property and the pleasure of the travellers.

Secretary James Wilson in a recent article says: "It will be good news to the whole nation to learn that road improvement is to be made a special study, and wide inquiry is to be set on foot among the several States as to the best ways and means of placing the highways of the country upon a superior basis." The Department of Agriculture has a little road office, by which a few thousand dollars a year are spent along the lines of both educational and practical work. One of these projects led to the sending out by the Department of Agriculture, within the last year, of experts, to meet and co-operate with different bodies in various States for the purpose of carrying on practical experiments with steel tracks that would enable the farmers to get their produce to market without running the risk of the heavily laden wagons sticking fast in the ruts of soft roads, soaked by continuous rains. These experiments have caused such a demand to be made for further and more extensive experiments to decide the best plan for road improvement that it has been decided to organize an office on broadened lines, and prepare it for doing more thorough work.

To this end it is proposed to divide the United States into districts; secure an educated agent in each of these districts, to study conditions, confer with scientists and practical road makers, address students and educational institutions, and make reports of work done and proposed to be done, that will form the basis of road literature. To begin with, it is proposed to locate the agents in the eastern States and the southern States, one in the prairie States and one in the mountain States of the far west. The value of this plan is that, as the conditions in the several localities are peculiar unto themselves, by a system of intercommunication between the various agents we shall gather the best information as to

the needs of the whole country and the best methods of inaugurating a scheme of national road improvement. The intention of the movement is to insure practical results in a matter that has long passed the talking stage. The Department of Agriculture will place at the disposal of the agents, in co-operation with them, the facilities of the experiment stations to be found in the various States, and every encouragement will be given for the formation of classes by road experts. In a word, the department is prepared to give the whole matter the broadest and most careful attention, with a view to the extension to the people of the various States of every possible assistance to better the conditions of the highways and lessen the troubles of those who use the public roads extensively.

More than half of the States have passed new and progressive road laws, and many hundred miles of good roads have already been built. New Jersey was the first State to take any radical step towards the improvement of her public highways. Her State aid law was passed in 1891. It provided that, on petition of the owners of two-thirds of the land bordering any public road not less than a mile in length, asking that the road be improved, and agreeing to pay ten per cent of the cost, the county officials shall improve the road, one-third of the expense to be borne by the State if the road is brought to the standard fixed by the State commissioners of public roads, and the balance, 66⅔ per cent, by the county.

This system seems to be popular with all classes, and is being carefully considered by the Legislatures of other States. Its principles have been adopted by Massachusetts, Rhode Island, New York, Connecticut and California. These laws, of which State aid is the principal feature, are regarded by the active advocates of road reform as affording a satisfactory solution of the problem.

Massachusetts, like New Jersey, has adopted a system of road improvement which it is believed will result in a few years in securing to her State highways that will be second in excellence to none in the United States, and equal to some of the best in the old world. Massachusetts has an abundance of the best material in the world for road building,

and her streets and highways should be an object lesson for every State in the Union.

Good roads are of vast benefit to agriculture. They increase the profits of the farm, by decreasing the cost of transportation It is cheaper to draw produce to market in one load than in two; and, in these times of sharp competition, good or bad roads may mean either profit or loss to the farmers.

Better roads for the farmers is a subject in which every grange in the State should take an active interest. Keep the matter before the people, have discussions on the subject in grange meetings, hold public institutes with good speakers on modern road building, keep the matter agitated, until the farmers get their just dues. Put the whole care of the highways in the hands of the farmers, if possible, and then we shall very soon have roads that are a credit to the State, and at a very moderate cost.

AGRICULTURAL ORGANIZATIONS.

BY HENRY C. COMINS OF NORTHAMPTON.

The origin of agriculture is lost in the mists of antiquity, yet tilling the soil was doubtless man's earliest occupation. The cereals, and perhaps some kinds of fruit, presumably first engaged his attention. The domestication of animals necessarily soon followed. Prof. W. Boyd Hawkins says that there is evidence that the domestication of animals was first accomplished in the central plateau of Asia. He also thinks that agriculture arose in the south of Europe, and gradually spread in all directions.

The natural tendency of mankind in the earliest times is supposed to have been averse to work, and perhaps it has not materially changed in modern times. But fate is stronger than will, and at various periods mankind has been forced to work. To speculate as to the time and reasons or necessity for the cultivation of the soil, while it might be interesting, would not result in definite conclusions that will materially benefit us or mankind generally, or determine for us whether it was by individual or organized effort. It is probable, however, that the natural laws of life, the survival of the fittest, which actuates both animate and inanimate nature, was the controlling influence which led to individual efforts to improve conditions. In all probability these efforts were largely imitative, and only as time advanced and necessity compelled were new methods adopted. The development of agriculture must have been slow at first, and only as necessity compelled was any progress made. The early settlers of our own land took no thought in regard to improvements, depending upon natural surroundings to a great extent to meet their necessities, rather than upon any well-directed effort for improvement for their future welfare, comfort or enjoyment.

Not until near the end of the eighteenth century, and the close of the revolutionary war and its devastating effects upon the people and the industries of the country, was there any awakening in regard to the improvement in agriculture. About this time public men in various parts of the nation interested themselves in the desirability, as well as the necessity, of improving the industries of the country, and especially its agriculture, realizing that it was the leading industry, and the one above all others upon which depended the welfare and prosperity of the people, as well as the development of the nation; and that, while individual effort could, if exercised with energy, do much, united action could do much more in fostering and encouraging the declining industries.

The end of the eighteenth century and the beginning of the nineteenth witnessed the organization of the first agricultural societies. At first with many of them the object was to encourage some particular agricultural industry, in which the promoters were especially interested, rather than all the agricultural resources of locality or country. The Berkshire Agricultural Society, one of the oldest in our State, having held its ninety-first exhibition as an incorporated society, was the outcome of the exhibition of some Merino sheep by one Elkanah Watson in 1809. Previous to this, there had been several organized societies. The first of which we find record was the South Carolina society, in 1784; the Philadelphia, in 1785; the New York, in 1791; and the Massachusetts, in 1792. All of these societies were organized by men not especially agriculturists, but energetic men of business, who recognized the importance of agriculture and the necessity of encouraging it as the leading industry, and the one on which all others depended for success and material prosperity.

These societies were regarded with suspicion or diffidence by those immediately engaged in practical farming, as being city organizations, promulgating theories not necessarily practical or useful in general farm management. Consequently, the benefits they were to be to the people were slowly comprehended. The average farmer was unwilling to adopt untried theories, however plausible they might

appear. He chose to follow the methods which had been tried not only by himself but by those who had gone before him, — methods that had produced enough for his subsistence, not realizing or even thinking of the demands which the development of the country in the near future would make upon the agricultural industries. The promoters were regarded as visionary, and, had they lived to-day, would be called cranks. It is a notable fact that almost every new enterprise or improvement, in whatever direction, has been promulgated or introduced by those who are considered cranks, — whose ideas it would not do to adopt or follow until thorough investigation and demonstration had proved their usefulness.

Farmers as a class are even at the present day slow to adopt new ideas, — not because they are less intelligent, but more conservative. A large part of the farms are situated away from the marts of business, and the necessity of giving his attention closely to the business on the farm takes and keeps him away to an extent from the whirlpool of business, and the defiant go-a-headitiveness which characterizes the congregation of people in town and city. His business and his surroundings have a tendency to make him conservative; and, while farmers as a class may be regarded as slow, the dependence placed upon them by those engaged in other industries is second to none in the community, State or nation. To their conservatism as individuals may be attributed the stability of their organizations. Societies organized a century ago, still in existence and doing good work, are evidences of this fact.

The charters of most agricultural societies state that they were organized to promote agriculture and the mechanic arts in the communities where they are located, terms broad enough to cover the several kinds or lines of agriculture and allied industries, wherever formed. The object of their establishment was a commendable one. Their worth and influence upon communities and people, wherever located, can never be counted or even estimated. While those most intimately and closely connected with them have received the most and greatest benefit, as the pebble thrown into the pool, creating a large ripple at first, continues its

influence until every drop of water contained therein is disturbed, so societies organized for the good of the people will affect all classes in the community to a greater or less extent. Agricultural societies established primarily for the improvement of stock and the productions of the soil have been a perhaps silent influence in the encouragement of other industries allied to agriculture. The improvement in farm machinery, intelligent fertilization, the convenient arrangement of farm buildings, the introduction of new varieties of crops, and many other things which we enjoy to-day, which add to our comfort and pleasure, have been stimulated either directly or indirectly by agricultural organizations. Changes have taken place in many of the features of their management and purposes, it is true, but this is only in keeping with the advancement going on all around us in every industry.

At the close of a century and the beginning of a new one it is profitable, as well as natural, for us to note some of the many changes that have taken place in the hundred years now past. To note all the changes that have taken place in our homes and upon the farms would be calling a long roll. A century ago not even in the homes of the richest was there a furnace or even an open grate or a bath-room or gas jet. The warming pan, the four-post bed with its curtains to be drawn when extremely cold, were among the luxuries then enjoyed. In those days the merchant kept his own books, and wrote his own letters with a quill pen and let them dry or dusted them with sand. Not a letter box existed or a stamp or an envelope. In the most populous places there was but one mail a day, and in the larger towns but one a week, while in the smaller and more remote places one a month was all that was expected. In 1799 there were but seventeen daily newspapers in all the United States, — not a magazine or an illustrated paper of any sort, or scientific paper or trade journal. All printing was done by hand. To print as much matter as is now printed by one of the most modern presses in one hour would have taken three months by the presses then in use. Not one of the many modern inventions now in daily use, and so common as not to receive a passing notice or thought, of when or where they were first constructed, then existed.

Could an individual of the eighteenth century come back, he would be overcome and completely bewildered with the many changes that have taken place along every line. Could he take up the daily paper of to-day, he would find it utterly impossible to understand the expressions he would meet in every paragraph. The advertisements of saleslady, the typewriter, the stenographer, the lineman, the gripman, the motorman, the conductor, the electrician, the elevator boy and a host of others, whose trades and occupations are so familiar, would be men and women concerning whose daily life and occupation he would be unable to form the faintest conception. Could the farmer of a hundred years ago come back, with what astonishment would he look upon the modern farm implements and machinery. He would be unable to conceive for what purpose they were made, or how they could be used. The sulky plow, the various kinds of harrows and cultivators, planting machines, reaping, mowing and other harvesting machines, horse rakes, potato diggers, lawn mowers and many others whose purposes he could not understand, would fill him with wonder and amazement.

It is next to impossible to note a tithe of the improvement along every line and in every direction. Indeed, human pursuits are so intimately connected and interwoven with each other that an improvement in one tends to the advancement of them all. The changes that have taken place in material things are hardly a measure of the changes that have taken place in the constitutions of the people and society, and especially in education. We of to-day are filled with wonder, if we but stop to consider the marvellous changes that have taken place within our own recollection along every line, and the wonderful improvement for our comfort and welfare.

In this wonderful advance, which is but the outcome of advancing civilization, agricultural organizations have been an agency, among many others, exerting an influence which may have been silent, yet none the less potent, organized for a specific purpose, the prosecution of which helped along the general advance and called for and made possible other and kindred organizations. The farmers' clubs and granges are organizations of this character, whose purpose

is to improve the educational and social condition of farmers and rural communities. So great and powerful has become their influence, not only in local communities but in State and nation, that legislative bodies regard their opinions and requests with deference, and the vast amount of good they have accomplished in educational and social improvement can never be estimated. Some of these organizations have attempted to make of themselves business organizations, with only partial success, and in some cases with disastrous results. This is but an illustration of trying to accomplish something outside of the main purpose for which they were designed, at the same time demonstrating the desirability of business organizations among farmers. Co-operative associations for business purposes among farmers are relatively new, and in only a few branches has co-operation been tried. Co-operative cheese and butter factories are perhaps the most extensive and successful of such organizations, and illustrate clearly what can be done in the way of business for the farmer and his products, greatly to his advantage, by combined efforts.

To-day those engaged in almost every kind of business are combining and organizing for their mutual benefit; and, while we hear a great many deprecating remarks in regard to trusts, we have yet to learn wherein they have been of material injury to any one, and in many instances they have cheapened commodities to the consumer. They have been of great advantage in the conduct of business to those who have formed them. Farmers as a class are slow to combine for their mutual benefit in business; but why should they not, as well as the manufacturers or the producers of any commodity? It seems to the writer that along this line of organization should the attention of the agriculturists be directed, thus taking themselves out of the hands, so far as possible, of those who get the largest per cent of what the consumer pays for the products of the farmer. Cheapening farm products to the consumer and getting more for himself are among the possibilities to be realized.

Agricultural societies and their annual fairs have had an influence which has affected the whole people in a greater or less degree, according to the interest taken in them. Nor

do I believe that their usefulness is passed, or the time come when they should be discarded. They may be, indeed they should be, changed in many respects to meet the demand of new and advancing ideas, and still be a power for good in promoting the agricultural and mechanical industries of the communities of State and nation. To forecast the future of existing agricultural organizations with any degree of certainty would be impossible. They will be, like everything else, subject to change, to meet wants and fulfil the demands of a progressive public spirit. Their influence can be measured only by the interest taken in them. As they are representatives of the leading occupation, and the one on which all others depend for material and even for existence, they should receive the most cordial support of the whole people. It would be a commendable object to impress the people with the importance of agriculture to all other industries; to call the attention of those engaged in other pursuits and industries to their dependence on agriculture for their success. There is a tendency, in the restless rush in business, which characterizes the American people, to forget the prime factors which lie at the foundation, so eager are they to reach conclusions at a jump. But stability in all things can be attained only when the foundations are secure. Let it be the grand aim of the farmer to so impress the importance of his occupation on all others, and so demean himself, that he shall be able to take the first place in the community and society, to which his vocation entitles him.

BULLETINS

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THE RELATION OF AGRICULTURE TO THE PUBLIC HEALTH.

BY DR. SAMUEL W. ABBOTT, SECRETARY MASSACHUSETTS STATE BOARD OF HEALTH.

In the study of man as a social being nothing is more evident than the fact that his comfort, his happiness, his health, almost his very existence, depend largely on his relation to his fellowmen. Robinson Crusoe had his man Friday; the hermit and the monk are more or less dependent on the outer world, notwithstanding any vow they may have made to lead a separate, isolated life. The philosopher Thoreau said, "I never found the companion that was so companionable as solitude. . . . It would be better if there were but one inhabitant to a square mile, as where I live." But even Thoreau, after living for two years as a hermit, found it best to return to civilized life again.

If this is true individually, it is true collectively. The great industrial classes — artisans, mechanics, laborers, teachers, professional men, sailors, fishermen, clerks and farmers — are all interdependent upon each other.

So, in the human body, every member makes every other member more useful, and each one increases the efficiency of all. The two eyes make the one pair of hands more useful than a dozen pair without eyes. Sir Charles Bell, in his "Essay on the human hand," shows that the thumb makes the four fingers more serviceable than a score of fingers without the thumb. "On the length, strength, free lateral motion and perfect mobility of the thumb depends the power of the human hand."

In the treatment of the subject, "The relation of agriculture to the public health," I shall deal with the question from different stand-points: first, in a subjective manner, that is to say, the effect of the occupation of agriculture

upon the farmer himself and upon his family; second, the relation of the occupation of farming or agriculture to the health of the community; and, finally, in a more general way, by a comparison of these two general branches with each other.

What is the effect of the occupation of agriculture upon those who have chosen this occupation? And how may their condition be improved?

Of all the occupations, trades and professions in which mankind are employed, that of farming is, with one exception, the most healthful and the most conducive to long life. I do not need to add that it is also the oldest of all industries, the most natural and the most important to the physical welfare of man. Let us imagine, for a moment, that the work of raising crops, milk products, fruit, cattle and other food animals were to cease entirely for a period of one year, and contemplate the effect of such an event. The cessation of any other industry which can be named could not produce so disastrous an effect upon the human race.

Let us examine this question of the healthfulness of agriculture as a profession or occupation more closely, with reference to the reasons.

In general, it may be said that out-door occupations are more healthful and conducive to length of life than in-door industries. In order to successfully till the soil, to raise crops and tend cattle and other animals, the farmer must necessarily lead an out-door life, as compared, for example, with mill operatives, shoemakers, book-keepers and other in-door occupations. Those occupations in which large numbers of people are employed together are unhealthful in proportion to the numbers crowded together in a given space. They are also unhealthful with reference to the character of the occupation in which they are employed. Occupations which produce irritating dust, like stone cutting, knife grinding, rag sorting, etc., tend to shorten the lives of workmen and produce consumption; while persons who live largely in the open air, like farmers and fishermen, escape such noxious influences.

The accompanying table presents some of these facts in a more definite manner: —

*Comparative Mortality of Men in Different Occupations in England.**

Clergymen,	100	Printers,	193
Farmers,	114	Cotton manufacture,	196
Paper makers,	129	Physicians,	202
Grocers,	139	Stone quarriers,	202
Fishermen,	143	Bookbinders,	210
Carpenters,	148	Butchers,	211
Lawyers,	152	Glass workers,	214
Shoemakers,	166	Plumbers and painters,	216
Commercial travellers,	171	Cutlers and scissors makers,	229
Bakers,	172	Brewers,	245
Masons and bricklayers,	174	Liquor dealers,	274
Blacksmiths,	175	File makers,	300
Railway laborers,	185	Earthenware makers,	314
Woollen manufacture,	186	Hotel service,	397
Tailors,	189		

The foregoing table may be read as follows: assuming the mortality of clergymen as a standard, that of farmers is fourteen per cent greater, that of lawyers fifty-two per cent greater, etc.

Another circumstance conducive to the health and long life of the farmer is the fact that, generally speaking, his food supply is more liberal and more varied than that of persons following other occupations, since he is the producer of the sustenance of the people, and therefore of his own. A good and sufficient food supply is essential to the well-being of every one. It is not only necessary that the supply of food should be abundant, but also that it should be well selected, sufficiently variable in character and of good quality; and these conditions are usually found to exist to a greater degree in the house of a farmer than elsewhere.

Again, the inherent character of the occupation makes it a promoter of health and longevity. The succession of crops, depending as they do upon the regularly recurring seasons of the year, occurs with harmonious regularity. If there is anything poetic, anything uplifting, anything tranquillizing in nature, who is the first and the most likely to receive these inspiring impressions if not the agriculturist?

* From paper by Dr. Wm. Ogle, at International Congress of Hygiene at London, in 1891; section on demography.

The rush, the hurry, the anxiety, the worry of the business man, the financier, the politician, the soul and body destroying conditions which surround the devotee of fashion, do not affect him. Undoubtedly he has his trials and perplexities, but, all combined, they cannot counterbalance or offset the general good influence of his occupation.

The average life of the lawyer, the physician, the mechanic, the soldier, the laborer, is in either case shorter than that of the farmer. So far as the medical profession is concerned, there is the constant and wearing influence of the sight of human beings suffering with pain and sickness, of witnessing death-bed scenes, of broken rest at night and of direct exposure to infectious diseases. I have often been asked the question, "Why do not doctors take or contract contagious diseases?" I answer that the assumption is entirely wrong at the outset. Physicians do take infectious diseases, and die with them in a greater ratio than the general population, and the same is true of nurses, hospital attendants and all others whose duty it is to wait upon the sick.

Country life in general is more healthful than city life. The death rate of the country is almost always less than that of the city. It is the constant stream of humanity that is always flowing from the country toward the city that keeps the city alive. The vigorous health of those who dwell upon the farms is in strong contrast to the weaklings who are produced by thousands amidst the densely crowded quarters of our large cities.

It was the Germans, the Goths and the Vandals, fresh from the fields and farms of northern and middle Europe, that finally prevailed over the Roman people, who had become enervated by the licentiousness, the excesses and debasing habits of city life. John Burroughs says, in contrasting the farmer and the dweller in cities: "A nation always begins to rot first in its great cities, is, indeed, always rotting there, and is saved only by the antiseptic virtues of fresh supplies of country blood;" and again he says: "The farmer has the most sane and natural occupation, and ought to find life sweeter, if less highly seasoned, than any other. He alone, strictly speaking, has a home.

How can a man take root and thrive without land? He writes his history upon the field. How many ties, how many resources, he has: his friendships with his cattle, his team, his dog, his trees; the satisfaction in his growing crops, in his improved fields; his intimacy with nature, with bird and beast and with the quickening elemental forces; his co-operations with the cloud, the sun, the seasons, heat, wind, rain and frost. Nothing will take the social distempers, which the city and artificial life breed, out of a man, like direct and loving contact with the soil. It draws out the poison. It humbles him, teaches him patience and reverence, and restores the proper tone to his system."

It is the out-door life, the keen observation of the every-day events of the farm and the forest, the watchful eye and ear, the minute observation of birds and their habits, of the squirrel, the rabbit, the weasel, the ferret, the fox, the muskrat and the woodchuck, of the multitudes of different kinds of insects both useful and injurious, that have given us such books as have been written by Gilbert White and Thoreau and John Burroughs and Bradford Torrey and Seton Thompson, — books that every observing farmer ought to have in his library to read in the long winter evenings.

But there are exceptions to every rule. I have said that the farmer is, with one exception, the longest-lived man. Were it not for certain circumstances, he would lead the list. How, then, may his condition be improved? I shall now direct your attention to a few of the points wherein improvement may be made.

And first, since I have spoken of the value of fresh *out-door* air in promoting health and long life, I will add to this that fresh *in-door* air is quite as important to those who live in the house, and especially is this true of the sleeping rooms. Too often does it happen in the modern farm-house that the sleeping rooms are too small, and are also wanting in the proper means of *ventilation*. Ventilation means the change of the foul air of the in-door apartment, and its renewal by fresh air from out doors. This cannot be done in a sleeping room in which the windows and doors

are tightly closed, unless special provision is made for renewing the air by means of an out-door opening, such as may be furnished by an open fireplace or grate; and even a grate is not a sufficient means of ventilation, so long as there is no fire in it. A man who lives in this manner year after year, breathing the foul air of a tightly closed sleeping room, cannot continue in good health. The actual cost of maintaining a house with good ventilation is somewhat greater than that of a house with no ventilation at all, since a greater amount of fuel is required for a well-ventilated house than is necessary for a house with no ventilation.

The Water Supply. — If pure air is essential to good health, so is pure water. From my own observation of very many farms which I have visited and inspected, I should say that the water supply of farms is, on the whole, better than that of thickly settled villages, in which the domestic water supply is drawn entirely from private wells. There are, however, abundant instances of badly polluted water supplies among the farms of Massachusetts, and when such farms are also dairies, producing milk for the supply of large populations, the polluted water supply becomes a serious danger and a menace to the public health.

I shall allude to this phase of the subject more at length in another connection.

The peculiar regard which each householder or house owner has for his own well is sometimes marvellous, when a single glance at its surroundings would convince even a casual observer that the owner's estimate is far from correct. The water looks clear and transparent; it has a sparkling taste; very likely the owner prefers it to any other water in the world. But clear and good tasting water is not necessarily pure water, and may be exceedingly polluted, as an ordinary chemical analysis often shows. It is necessary, therefore, in locating a well, to place it in such a position that no foul drainage from any source can possibly enter it, either by filtration through the ground or by surface flow over the ground. The cow yard, the back yard of the house, the barn cellar, the house cellar, the neighborhood of the hog sty and the cesspool, none of these places is suited for the site of the well. As a general rule,

it would be preferable to place the well above the house and barn, in higher rather than in lower ground, unless some neighbor's house, and consequently his drainage system or want of system, happens to be on still higher ground above the well. In hilly and mountainous regions it is a common and an excellent practice to draw the water for the farm from a spring at an elevation on the mountain side, above the house and away from all possibility of contamination.

In connecting such springs with the house there is, however, an element of danger which deserves a moment's notice. I refer to the use of lead pipe. Under certain conditions and with certain waters lead pipe is used continuously and without harm; but this is not always the case. It is only quite recently that I have investigated a serious epidemic of lead poisoning in a small village furnished with a public water supply, where some thirty or forty people were poisoned with lead, and some of them quite seriously. In all these cases of poisoning I found that unusually long lines of lead pipe were used to connect the houses with the street mains. I also found that little care had been taken to draw off the water which had stood in the pipe over night before using it in the morning. With this precaution the danger is greatly diminished. It is much safer, however, to use no lead pipe at all. Iron is entirely safe, and the added cost of occasional renewal of the pipes does not impose a serious tax upon the house holder.

Drainage. — Having considered the water which enters the house, let us now spend a few moments upon another and a similar question, — the water which goes out of the house, that is to say, the drainage or sewage of the house; in other words, the water which has entered the house, with the addition of such refuse as the household may add to it. The location of farm-houses at a distance from densely settled communities usually prevents their connection with public systems of sewerage; hence it becomes necessary to take care of the house drainage upon the farm itself.

A repulsive pool of foul-smelling sewage near the back door of the farm-house or under the windows of sleeping rooms is not a pleasing or a healthful ornament to the homestead. If a cesspool is used to receive the sewage, it should

be so constructed that no foul odors from it can escape into the house, and this can best be done by a perfect trap between the cesspool and the house. The ordinary bell trap at the sink is not a sufficient safeguard. Another plan is to dispose of the drainage into small subsoil pipes loosely laid, so that the contents may pass outward into the soil, to be used by the growing crops.

Food. — Another important element which influences the health of the farmer is his food. Several years ago the State Board of Health made an investigation in regard to the food of the people of Massachusetts, very much of which related to the food of farmers. I will quote the most important of the conclusions which they published at that time: —

1. Good bread is scarce, and is too often made with some unwholesome substitute for yeast.
2. There is too little variety in food.
3. Meat is too often fried.
4. Pastry and cakes are used to an injurious extent.
5. Too little time is allotted for meals.

The quality of the beverages taken with meals is a matter of no little importance. Coffee, tea and cocoa form a useful addition to meals, when they are not taken in excess. Intoxicating drinks should be banished forever from every farmer's table, since no man can tell when he has passed the danger line in their use, so far as the effect upon his health is concerned.

There are certain curious fallacies in regard to the use of food, beverages and drugs, which are worthy of a moment's consideration. One of these is the popular belief, which has prevailed for many years, which attributes to phosphorus and its compounds in food an unusual importance in promoting the growth of the brain and of the intellectual powers. Hence much stress is given to the eating of fish, and the use of acid phosphates as beverages. That this curious theory has little foundation, however, is pretty well proven by the following facts: —

1. There is no evidence to show that the brain requires phosphorus more than the bones or other organs of the body.

2. Fish contains no more phosphorus than other kinds of animal food, and the unbolted cereals, wheat, oatmeal, rye and Indian corn.

3. People who are most accustomed to a fish diet, *i.e.*, fishermen (the natives of Cape Cod and of fishing ports generally), do not give evidence of possessing unusual intellectual powers.

A young writer once sent a communication to Mark Twain, asking his opinion as to the use of fish as a food for developing the brain, at the same time suggesting that Professor Agassiz had recommended the eating of fish for that purpose. He replied: "Yes, Agassiz *does* recommend authors to eat fish, because the phosphorus in fish makes brains. So far, you are correct. But I cannot help you to a decision about the amount you need to eat. If the specimen composition you send is about your fair, usual average, I should judge that perhaps a couple of whales would be all you would want for the present, — not the largest kind, but simply good, middling-sized whales."

Another source of harm exists in the excessive use of patent medicines. Under the false impression that some sort of drug must be taken in the spring to "purify the blood," to cure a "tired feeling," to "make the weak strong," pounds of iodide of potash are taken under the false name of sarsaparilla, of saltpetre under the name of kidney cures, of alcohol under the name of celery compound, nervura and so on. All of these preparations are injurious, and are constantly undermining the health of the victims who are continually dosing themselves with them.

Recreation. — The kind of recreation most needed by any man depends very much upon the character of his occupation. To the farmer, who has held the plow all day long in spring time, or swung the scythe in midsummer, or cut and piled several cords of wood in winter, it would be superfluous advice to tell him to spend an hour or two a day in rowing or in kicking foot-ball by way of exercise at the close of the day. Exercise to his weary limbs would not be restful. These are the kinds of recreation which are most useful for the clerk and the book-keeper, whose life is mainly sedentary and confined within closed apartments.

On the contrary, the farmer needs a milder pastime, that will be at once restful and an absolute change from his hitherto toilsome labor. Fishing, sailing or some sort of in-door game will divert his mind from the toils of the farm, and give needed rest.

I call to mind a man who, in my boyhood, passed my father's door every day with a cart or wheelbarrow on his way to his farm, which was at some distance from his residence. He worked hard, early and late, and accumulated a handsome property for those days. He worked on, day after day, doing the work of two men and more, without rest or relaxation of any sort. So hard did he work that fits of sleeplessness and despondency ensued, and finally one day, on returning from the village school opposite my father's house, my mother called me to her and said, "Mr. B. is dead; he has killed himself." He was then fifty years of age, and died of incessant work.

Good reading constitutes another excellent form of recreation for the farmer, and no farmer's household should be without at least the means of access to a good library, and to this should be added a subscription to some good farm journal, with such other periodicals as his means may permit. These are forms of mental recreation, to be sure, but the harmonious development of the mind and body is essential to good health and contentment.

I come now to the second topic, — the influence of agriculture upon the public health. It may be inferred from what I have already said, that, without agriculture, there would be no such thing as public health, since man would cease to exist; hence agriculture is, of all things, one of the most essential to the public health. It produces the sustenance wherewith man is supported and his life maintained. The phase of the subject, therefore, to which I shall now call your attention is the method by which this influence upon public health can be maintained in its highest perfection; since there are certain ways in which the farm, occasionally, and through some neglect of due precautions, becomes a source of danger.

The diseases to which man is subject are several in number, but those which are of the greatest interest to us in this

connection are very few. Some of them are common both to man and to animals, and some are not. Those which are of peculiar interest to the farmer, and which occasionally cause him more or less anxiety, as well as pecuniary loss, are tuberculosis or consumption, typhoid fever, trichinosis, glanders, rabies, and anthrax, or malignant pustule. Of these diseases the cow is subject to one or more, the horse to another, the hog to another, the sheep and horse and cow to another, the dog to another, and man to all of them. But all except the first two which I have named are of such rare occurrence in man in this State as to be scarcely worthy of mention as causing any serious harm to our living population. All told, they produced only one thousandth part of the number of deaths which were caused by consumption in the last fifty years in Massachusetts.

The question whether tuberculosis in the cow is the cause of the same disease among men, in consequence of the eating of meat and the drinking of milk from such animals, has been a live issue for several years past, but definite and decisive evidence as to the exact relation of the disease in the cow to that in man still appears to be wanting. So long, however, as there appears to be a doubt in the matter, it is assuredly the safer course to use only such meat and milk, and especially milk, as comes from healthy animals.

In the ease of typhoid fever a very different question arises. Here we find a disease which never occurs in the cow, but is peculiar to man only. Unfortunately, it is of too common occurrence in the farming districts, and is due most commonly to a polluted water supply. When it occurs upon a dairy farm, it occasionally causes serious disturbance on account of its liability to infect the milk supply. Hence it should be laid down as a rule, that *no person who is ill with any disease whatever*, and especially with any infectious disease, should be allowed to have any part in the work of a dairy. Another important point is the care which should be taken in disposing of the discharges of persons who are ill with typhoid fever. Thorough disinfection of such discharges should be made with chloride of lime. A man who is only slightly ill with typhoid fever, and able to attend to farm work (and such cases are quite

common), is far more dangerous than one who is sick in bed, since the latter can have no direct connection with the milk supply.

In order to consider the operation of such cases, let us suppose a case. An epidemic of typhoid fever is found to exist in a city of twenty-five thousand people. Twenty cases or more of typhoid fever are reported to the city board of health. There are fifty milkmen who supply the city with milk from the neighboring towns. All of these cases of typhoid fever, or nearly all, are customers of one milkman. This circumstance directs the attention of the board of health to this milk route, and, on further investigation, a case of typhoid fever is found to exist at the dairy where the milk is produced, and a careless method of handling the milk is also found to exist. I need not specify the circumstances which are often found to exist in actual experience. The evidence of these facts is in most instances sufficient to establish a presumptive connection at least between the typhoid fever at the dairy and that which exists on the route of the distributer.

Within the past ten years I have been called to investigate several outbreaks of another disease, — trichinosis, — which is not very common among the native New England population. It is always and invariably due to one cause, — the eating of pork, and also of uncooked or insufficiently cooked pork. Fifty cases and five deaths occurred from this cause in the town of Colrain in Franklin County a few years since, all among Germans or other European immigrants, and all were due to eating raw pork. The disease in the hog is caused by bad methods of feeding, and it usually exists in a very considerable percentage of hogs which are swill-fed. The State Board of Health, during the past few years, has conducted experiments at two State institutions which show that the disease may be entirely prevented in the hog by cooking his food, and by ceasing to feed out the entrails of slaughtered hogs.

I have said enough in this direction to establish two important principles in regard to farm and dairy work: first, the necessity of absolute cleanliness in every department of work; and, second, the rule which I have already stated, —

that no person who is ailing or even slightly ill with any infectious disease should be permitted to have any part in dairy work until such person has entirely recovered and has been pronounced well by the attending physician. If these rules are followed, the milk producer will have less occasion to complain of frequent loss in the sale of this most useful article of food.

A great stir has been made in Europe in recent years, with the object of preventing the importation of certain fruits, the products of American farms. The reasons alleged, chiefly by the German government, were that poisonous insecticides were used for the spraying of fruit trees in the United States. Another reason alleged was that zinc had been found in dried fruits. This statement rests upon the fact that apples and peaches and other fruits are often evaporated or dried upon zinc trays, and hence small amounts of metallic zinc are occasionally found in the fruit. The amount, however, is so small and the form in which the zinc is found is such that no harm need be feared from this source.

The practice of spraying fruit trees in the season of blossoming and for a few days afterward has become widespread, and demands a moment's notice. The substances used for this purpose are, some of them at least, deadly poisons. Arsenic in the form of Paris green and London purple, with sulphate of copper or blue vitriol, are employed for this purpose, and these make the most efficient means for destroying the various insect pests which attack our fruit trees, currant bushes, potato vines and other plants.

In the case of fruit trees, like the apple, the principal insect pests are the American tent caterpillar and the canker worm, each of which usually hatches and begins and completes its destructive work between May 10 and June 20. Now, the season of harvest for the great volume of the apple crop is about October first, and probably none which are raised for export are gathered before September first. There is, therefore, a period of from two to three months, in which the average rainfall is about three inches per month, — a quantity amply sufficient to wash away all traces of the spraying substances from the fruit and the leaves.

In the summer of 1896 I made the following experiment. Having built a small platform in the crotch of a large old apple tree, about fifteen feet from the ground, I took a two-gallon pailful of Paris green mixture up to the platform about three times a week, and sprayed the whole tree from this platform, alternating occasionally with a solution of sulphate of copper. At least half of the sprayings were of Paris green. This mixture was so strong as to destroy some of the smaller branches near the centre of the tree. The sprayings were continued till at least a dozen doses had been applied between May 15 and June 15, and the canker worms were pretty thoroughly destroyed. A good crop of unusually fair apples began to appear, and were of three kinds,— Dutch Codlings, Gravensteins and Danvers Sweets. The early apples were picked about September 5 and the late sweets about October 5 or later. Several of these were selected, of two kinds, together with some of the leaves, and were submitted to the State chemist for analysis, and he reported that not the slightest trace of either arsenic or copper could be found in them.

It should, however, be borne in mind that Paris green is a deadly poison, and when used on the farm, either for destroying the pests of fruit trees or potatoes or even larger vermin, like rats and mice, the greatest care should be taken to put the supply of poison out of the reach of children and of animals.

In what points do these general branches, agriculture and public health, resemble each other?

In point of usefulness to the community, agriculture and public health have a great deal in common. Agriculture provides the means wherewith life is sustained, the sustenance essential to the continuance of the human race. Nine-tenths of all the food used throughout the world is the product of agriculture. How essential it is, therefore, that this most useful branch should be developed in the most thorough manner and maintained in the most perfect degree.

As it is true that agriculture maintains life, it is also true that public health or hygiene protects life. Although the term preventive medicine is of comparatively recent origin, the practical application of the science is by no means new.

Moses applied it many centuries ago in the preventive treatment of leprosy and in the management of camp life. In the middle ages nineteen thousand lazarettos were necessary to provide shelter in continental Europe for the outcasts from this disease. Dr. Jenner applied it when he introduced the practice of vaccination for the prevention of small-pox, a hundred years ago. But it is only within the past half-century that systematic and careful study and attention have been given to public hygiene, with the view of training young men in the science of preventive medicine, or the art of prolonging life. It is a fact capable of easy demonstration, that, since careful attention has been given to the subject of preventing the spread of infectious diseases by means of notification, isolation, disinfection and vaccination, and still more recent methods of treatment and prevention by means of the taking of cultures and the use of antitoxin, the death rate from the infectious diseases has been sensibly diminished and the length of human life correspondingly prolonged; and this is notably true of England, the country where the most careful attention has been given to the subject and the greatest amount of money expended in its accomplishment.

Public hygiene or preventive medicine, again, is like agriculture in its method of dealing with those evils which, on the one hand, destroy human beings and limit their progress, and, on the other, those which seriously interfere with the abundance and the quality of growing crops; and the principles of prevention which are applied in either case are very much alike.

If a sound, healthy infant, born of healthy parents, were to be placed in a glass case, and fed with pure food which had been freed from all germs of disease by due process of sterilization, and were constantly supplied with pure air which had also been sterilized; if the water which it drank were to be always pure spring water, and if in all other points it were to be treated on perfectly healthful principles, such an infant would never die of measles or small-pox or scarlet fever or typhoid fever or whooping-cough or consumption.

So, also, in agriculture, if an apple tree or a peach tree

were to be enclosed in a glass case, where it would be supplied with abundance of sunlight, with filtered water and sterilized air and soil deprived of all pathogenic germs or eggs of noxious insects, no canker worm or caterpillar or gypsy moth or any other pest could possibly molest it, and its leaves and flowers and fruit would mature and ripen in fairness and beauty. This is the principle of isolation.

There is also a great similarity in the methods of spread of infectious diseases and of insect pests; and, while there is a similarity in the general group of infectious diseases to that of insect pests, there are also many points of specific difference.

Influenza, for example, spreads with amazing rapidity, and attacks great tracts of country in a few hours' time. It appeared in Boston about Dec. 19, 1889, and in less than a week had also appeared in nearly every city of the northern States. One class of diseases, cholera and typhoid fever, spreads through the medium of water supplies; another class, including small-pox and scarlet fever, by means of the air and by actual contact. The spread of consumption is favored by the presence of dust diffused through the air of rooms and carrying with it the germs of disease.

So, too, in agriculture, the various insect pests differ in the method of their spread. The female canker worm ascends the trunks of trees in the warm days of late autumn or early spring, and lays her eggs on the twigs, to be hatched in the months of May or June. Hence the mode of prevention is to place a barrier upon the trunks of the trees, which shall hinder the insects from gaining access to the branches. So with the American tent caterpillar. This insect lays its eggs upon the small outer twigs of the trees, in bunches of several hundred eggs in each, carefully varnishing the bunches to protect them from the weather. Destruction of these bunches or belts of eggs, or of the young caterpillars as soon as they are hatched, is the only practical mode of dealing with them.

Again, the same substances which destroy noxious insects are also used in medicine as disinfectants, and the careful study of their action will advance the cause of agriculture. The farmer who carefully applies the right form of insecti-

cide to his potato vines during the growing season will insure the best crop. So, also, with his fruit trees; a careful application of spraying liquid of such strength as not to injure the trees, but strong enough to destroy the insect pests, will insure the best crop of fair and handsome fruit.

So the health officer, who applies disinfectants judiciously and intelligently, will be rewarded in finding that scarlet fever, diphtheria and other pests of mankind will not recur in the same household unless introduced from outside sources.

I cannot close this comparison without reference to the labors of one man who has lately passed away from earth to his great reward, and who was a common benefactor both of the medical profession and of those who till the soil. He was much more, — he was a benefactor to the whole human race. I mean Louis Pasteur. Born in the little town of Dole, in France, of humble parentage, his father was a veteran French soldier, afterward a tanner. The son Louis early in life became an enthusiastic student of nature and of natural laws. More than a half-century ago he had begun the course of experimental research which destined him to become one of the greatest allies of the medical profession and of agriculture that the world has ever known.

One of his first triumphs was the discovery of the cause of the silkworm disease. In 1849 and 1850 the silkworms were attacked with a parasitic disease which caused the loss to France, in the silkworm industry alone, of $20,000,000 in a single year. The plague spread to Spain and Italy, and finally no eastern country was exempt from its ravages except Japan. Pasteur was urged to study the subject, with the view of finding the cause of the disease and its prevention. He gave his whole attention to this question for nearly three years, and so zealously did he pursue his experiments that his health broke down, he became enfeebled, and was stricken with partial paralysis in 1868, while he was in the midst of this important work. He had, however, already found the cause and the mode of prevention, which consisted in separating the healthy moths from those which were sick, carrying out the true principle of isolation in infectious diseases, and thus he restored the silk industry

to France. He never fully recovered from the partial paralysis which he suffered, so far as his body was concerned; but for nearly thirty years his mind remained undimmed, and during these thirty years he discovered the mode of curing those who are bitten by mad dogs, until his institute at Paris became the centre to which afflicted people resort from all parts of Europe for treatment. Another important discovery which he made was the cause of fowl or chicken cholera, to which he also gave earnest attention and found that this, too, was a parasitic disease. The disease known as splenic fever or malignant pustule next attracted his attention. A young veterinary surgeon (Dr. Louvrier) had proposed a definite method for treating the disease, which has always been very fatal to sheep and cows in France and Russia. Pasteur immediately entered upon the investigation of this disease, and in less than two years he had solved the question, and a day was appointed for a public trial or test of its efficiency. I will let his biographer tell the story in his own words: —

Pasteur accepted. The experiments were conducted at Melun, May 5, 1881, a few miles above Paris, on the Seine. The Society of Agriculture agreed to place at his disposal sixty sheep. The results of these experiments were absolutely successful and convincing to the most sceptical.

There was a burst of enthusiasm at these truly marvellous results. The veterinary surgeons especially could not recover from the surprise. They examined the dead, they felt the living.

"Well," said M. Bouley to one of them, "are you convinced? There remains nothing for you to do but to bow before the master," he added, pointing to Pasteur, "and to exclaim, 'I see, I know, I am undeceived.'"

Having suddenly become fervent apostles of the new doctrine, the veterinary surgeons went about proclaiming everywhere what they had seen. One of those who had been most sceptical carried his proselytising zeal to such a point that he wished to inoculate himself.

An extraordinary movement was everywhere produced in favor of this method of preventive treatment. A great number of agricultural societies wished to repeat the celebrated experiment. The breeders of cattle overwhelmed Pasteur with applications for vaccine. At the end of the year 1881 he had already treated 33,946 animals. In 1882 the number amounted to 399,102.

But Pasteur still lives in his works. He lives also in his pupils. To one of these we owe the recent discovery of the most potent means which have yet been found for diminishing the fatality of that terrible scourge and destroyer of children, *diphtheria*. From the teaching of this man there comes help to the agriculturist and to the physician, — yes, to all mankind.

Let me not close without commending to every farmer, as an addition to his library, the biography of such a man as Pasteur, together with the works of Thoreau, of John Burroughs, of Bolles and Bradford Torrey, and of good old Gilbert White of Selborne. It is from the study of the writings of such men that our eyes are opened to see the life that surrounds us in the woods, the fields, the ponds and the streams, and to learn from every living thing some new and useful lesson.

SOIL EXHAUSTION.

BY GEO. E. STONE, PH.D., PROFESSOR OF BOTANY, MASSACHUSETTS AGRICULTURAL COLLEGE.

The problem of soil exhaustion is one with which the farmers of Massachusetts have been brought face to face for many years. The land in this State has been deforested a number of times, and has been under cultivation or utilized for agricultural purposes for many generations. Hence, the original condition of the soil, with the primitive storehouse of available plant food, has been greatly modified. The two factors that exert an influence on the soil are its chemical composition and its physical properties. These two factors are intimately connected, and, in general, one cannot be modified without changing the other. The chemical composition of the soil is fully as important for plant growth as its physical properties. The soil, however, may contain tons of plant food which are not available. On the other hand, the physical conditions of the soil should be adapted to the plant, in order that normal root respiration may take place. Unless the physical conditions are adapted to the plant requirements, the amount and kind of available plant food exert very little influence upon the growth of plants. Many plants, however, possess a wide range of adaptability, and are not restricted to a definite soil texture. In some cases it is also essential that the particles of soil be of sufficient size, and their arrangement of a certain order, so that air spaces of a definite size are formed, adapted to the particular plant under cultivation. It is, therefore, not only the size of the particles but their arrangement which determine the physical properties of the soil. The water-retaining capacity of the soil is dependent upon its physical properties. A light, sandy soil from Cape Cod possesses a water-retaining capacity of thirty-five per cent,

while the heavier inland soils possess sixty to seventy per cent. A soil, for example, that is adapted to onions is not adapted to lettuce, and one which will grow potatoes will not necessarily grow tobacco. The influence of the physical properties of the soil can best be seen on our native species of plants. Every farmer has noticed the fondness of the white birch, pitch pine and scrub oak to dry, sandy or gravelly soils; and these plants are seldom seen on the heavier clay soils. There are, in fact, a considerable number of native plants in our State which are so particular about the physical condition of the soil that they can only be found in those localities where soil of a certain texture abounds. The peculiarities in the distribution of the wild plants would scarcely be noticeable except to a botanist, who has paid some attention to the physical conformity of our flora; and a knowledge of the habitats enables one to form a reliable conception of the nature of the soil upon which they are found growing. The rattle-box (*Crotalaria sagittalis*) and the barberry are types of such plants, as, to a less extent, is the red cedar; the latter species seems to delight in the presence of numerous cobble-stones as a soil condition.

It is our intention to consider the chemical and physical changes which have taken place in our Massachusetts soils during the past two hundred and fifty years, and to ascertain whether the common methods of cultivation which have been in vogue are well adapted to produce crops of the same magnitude as those formerly produced. During the last decade we have heard much of abandoned farms and worn-out soils. Yet it is well known that these farms were not always in a sterile condition, but that they contained at one time a considerable quantity of plant food.

Inasmuch as the predominance or scarcity of our wild plants in certain localities gives us a clue to the soil conditions under which they are growing, we may consider their adaptation as a means of determining the changes which have taken place in our soils. There are also many scattering historical records which show us that plants which were once common have greatly decreased in numbers in certain localities during the last fifty or one hundred years. It is

not necessary for us to give a complete list of these plants which historical records and present distribution indicate to have become less common; we will, therefore, take into consideration only a few of them. One of the most notable of these is the wild strawberry. This crop has so diminished in the greater part of Massachusetts that one cannot procure, without diligent search, a pint of berries in half a day. In olden time, however, this crop was exceedingly large, hence the practice of growing the fruit in gardens was wholly unnecessary; and, as a matter of history, the strawberry was not cultivated to any great extent in this State previous to one hundred years ago. The former abundance of the strawberry in Massachusetts is mentioned by William Wood in 1635, and also by Roger Williams, in Rhode Island, in 1643, who stated that he had "many times seen as many as would fill a good ship within a few miles compass." It is well known to men now living that it was possible not more than seventy-five years ago to gather a half-bushel of strawberries in a few hours in certain localities of this State, where a gill cannot be found at the present time. Many of our native grasses have diminished in like manner. Among trees we find the beech, canoe birch and hemlock less common, the latter having fallen off to an enormous extent; while such plants as orchids, ginseng, hobble-bush and a host of others have become much less common in certain localities. This is evident to any one who has taken pains to study the past and present distribution of these species, and who has taken into consideration their natural environmental adaptations.

The question naturally arises, What is the cause of this change in our floral conditions? This can be answered in a few words. It is due to a decrease in the organic matter of the soil and its associated humus compounds. There are other influences, however, which are in part responsible for the disappearance of certain species, notably the hemlock, where the condition of light for the growth of seedlings is at fault. It is, nevertheless, a lack of organic matter which is responsible for the decline of these species, taking them as a whole. In order that we may see the differences in the amount of organic matter that exists in a soil approaching

the primitive condition and one that is more or less run out, let us examine the following table. These analyses were made in each case with water-free samples.

Table showing the Amount of Organic Matter in Some Massachusetts Soils.

SAMPLE.	Organic Matter at Surface (Per Cent).	Organic Matter Eight Inches below Surface (Per Cent).
1. Approaching primitive conditions, . .	31	20
2. Waste land (heavy soil), ...	5	2
3. Lettuce soil (greenhouse), . . .	15	–*

* Practically the same as at the surface.

The percentage of organic matter shows, as might be expected, remarkable differences. Sample No. 1, which approaches primitive soil, was taken from a region where deforestation has not been common, and the large amount of organic matter represented here is the result of years of leaf-decay. The color of the surface soil is black; at eight inches below the surface it is only a trifle lighter. Sample No. 2 presents a yellow color below the surface, on account of the slight amount of organic matter present. This sample, which supported a growth of inferior grasses, goldenrods, etc., presented a dark color only at the surface. Sample No. 3 is a greenhouse soil, adapted to forcing crops. These soils usually contain from eight to fifteen per cent of organic matter to a depth of twelve to fifteen inches which is supplied by manure and by the decay of roots.

Those plants which have shown the greatest tendency to become rare, and in most instances are only to be found where there is more or less of an approach to primitive soil conditions, are the humus-loving plants, or those which depend upon organic matter. Not only is the number of humus-loving plants decreasing, but their former luxuriance is by no means the same. Certain wild species of plants, when grown in a soil similar to sample No. 1, are from one-half to three times as large as those grown in soils which

contain a superficial layer of organic matter of a smaller percentage. There are limited areas in this State where the soil approaches a primitive condition, and in such places plant development is much more luxuriant than in soils containing little organic matter, which is so typical of many of our present soils. With the exhaustion of the organic matter in the soil there has taken place a change in its chemical and physical properties. It no longer possesses the same water-retaining capacity or the same amount of available plant food. In this way the floral conditions have been changed, and, instead of finding the characteristic species of plants which once thrived in these soils, we find their places taken by such species as the white birch, poplar, bush clovers (*Lespedezas*), goldenrods, beard's-grass (*Andropogons*), Indian grass (*Chrysopogon nutans*), etc.

The cause of the decrease in organic matter may be traced to various operations. During the time of the early settlement of Massachusetts our ancestors found here woodland which contained an exceptionally fine growth of trees, constituting a forest difficult to penetrate. Here and there were open fields containing native grasses and herbaceous plants, growing luxuriantly, and our large river valleys were especially noted as being free from dense forest growths. This native growth exhibited a natural adaptability subjected to the laws of natural selection, as its conformity to physical conditions was not disturbed to any great extent through the agency of man. These natural conditions had probably existed since the glacial period, possibly ten thousand years; and a considerable amount of organic matter, due to centuries of decay, covered the surface of the soil. Some of the clay hills had already been cleared by the Indians in early times for agricultural purposes, and were in turn eagerly sought by the English 'migrators. The profuse growth of timber trees constituted a hindrance rather than a blessing to the early settlers, in consequence of which large tracts of primitive growth were cut and burned on the spot. By this process a large amount of wood ashes was formed, which gave rise to remarkable crops of white clover, but at the same time the deposition of years of organic matter of a priceless value was destroyed. The cutting and burning

FIG. 2. Effects of turning under a crop of mustard (non-leguminous) upon the growth of oats. Both pots were supplied with potash and phosphoric acid equally, but not with nitrogen. The pot marked "Senf" had mustard turned under; the other one had none. No immediate effect is shown on the growth of the oats by the previous crop of mustard.

Fig. 3. Effects of turning under a crop of vetch (leguminous) upon the growth of oats. Both pots were supplied with potash and phosphoric acid equally, as in Fig. 2. The pot marked "Salpeter" received its nitrogen in the form of saltpeter; the one marked "Wicken" had vetch turned under, showing that it was equal to saltpeter as a source of nitrogen.

process has been going on ever since, much to the detriment of the organic matter and crop-producing capacity of the soil. The open fields and meadows were once rich in organic matter, but these have become depleted through our methods of farming, which have consisted in taking everything from the soil without making much attempt to replace what has been removed. Had the practice of plowing in green crops been in vogue from the earliest times, our soil would have shown much more of its primitive character, and its productiveness would have been much different at the present time.

The constant depletion of organic matter which is taking place in all of our soils is one of its most marked characteristics at the present time, and with this decrease have come inferior crops, an additional increase in certain weeds, and, as already pointed out, quite marked changes in the abundance and habitats of our native plants. It remains for us to consider how these exhausted soils can be brought back to a condition resembling their primitive form. It would take, to be sure, some centuries to restore these soils, as this would require the deposition and decomposition of an immense amount of vegetable matter. Inasmuch as nature has often assumed the role of teacher in other matters, we may profitably turn to her guidance in considering how to make our depleted soils more like those formerly existing here, and consequently better adapted to support a crop.

The most rational method that we know of at the present time appearing to accomplish this to a certain extent is the continual plowing in of green crops. This practice is by no means resorted to as much as it should be by farmers. The cultivation of cover crops and subsequent turning of them under not only increases the organic matter and food constituents of the soil, thereby giving rise to larger crops, but most favorably modifies the physical conditions. Cover crops also conserve soil nitrogen, and prevent, to a large extent, the soil from washing during winter. A soil enriched by organic matter will retain more moisture, and hence is better able to withstand drought. No small compensation for the trouble of green manuring consists in keeping the weeds down. A field of corn sown with any crop during

July is the best guarantee the farmer can have against weeds. A field not sown down will, as is too often the case, be covered with Roman wormwood, pigweed, and other undesirable growths. The plowing in of green crops should be practised on all land subject to cultivation whenever there is a possibility of so doing. With corn, a crop of red

HORSE BEAN. RED CLOVER.

FIG. 1. Nodules on the roots of legumes.

clover, mustard or melilotus (sweet clover) can be sown after the last cultivation, and this can be cut and utilized for feeding, and the roots plowed under just before the next year's planting. The common red clover and sweet clover possess an advantage over mustard, as their roots are provided with nitrogen-containing nodules, the product of bacterial activity (see Fig. 1). In this case a certain amount of nitrogen is added to the soil, whereas with such

crops as rye, mustard, buckwheat, etc., no such bacterial adaptation occurs, and the soil nitrogen will not be increased from atmospheric sources. The leguminous plants constitute the best catch-crops, on account of the peculiar nutritive adaptation existing between the nodular bacteria and the atmospheric nitrogen. A crop of these plants can be sown, and just before reaching maturity they can be cut, and, if necessary, fed to stock. The roots containing organic matter and a store of nitrogen can be plowed under. We have practised this system in our greenhouse to good advantage, — a practice which, as far as we know, is not made use of in greenhouses to any extent. During the summer the greenhouse, which is devoted to winter cucumbers and lettuce, generally lies idle, and by sowing a crop of white lupine (which will develop in about six weeks under these conditions) or some other legume we succeed in adding to our soil a needed supply of organic matter and nitrogen. Experiments have shown that a crop of legumes plowed under is practically equal to a normal supply of nitrogen to the soil (see Figs. 2 and 3).

A certain stage of development in the crop is necessary in order to obtain the largest supply of nitrogen. This stage probably coincides in most cases with that when the seed are maturing. There has been a considerable number of leguminous plants grown for test purposes at the Hatch Experiment Station in Amherst during the past ten years or more, such as the white lupine, horse bean, serradella, alfalfa, soy bean, melilotus, Canadian pea, the various clovers, etc. Unfortunately, however, the majority of these winter-kill in our climate, and only a few of them can be used for winter soil-covers. Among those best suited for our climate is the common red clover and the melilotus or sweet clover. The latter, when sown in July, or at the time of the last cultivation of the soil, is capable of attaining a height of twelve or fifteen inches the following May, at which time the crop can be cut and utilized, and the nitrogen-containing roots can be plowed in. The red clover is also useful as a soil-cover, but does not always make sufficient growth in time for spring planting, being considered by some to be less desirable on this account than the meli-

lotus or sweet clover. The crimson clover is used as a soil-cover and for green manuring extensively in the south, where it is hardy; but repeated trials have shown that it cannot be depended upon in Massachusetts, although it is not improbable that it might winter on some of our sea-coast lands. There are some twenty-eight species of wild herbaceous leguminous plants common to Massachusetts, which so far as they have been examined by us, produce nodules upon their roots, and, much like those named above, are capable of utilizing the free nitrogen of the air and adding it to the soil. None of these species, so far as I am aware, have received any attention as to their possibilities of being utilized as nitrogen gatherers. Many of these species, such as the bush clover (*Lespedezas*), wild lupine (*Lupinus perennis*) and rattle-box (*Crotalaria sagittalis*), are peculiar to worn-out soil, and in all probability the rather sparing growth of these plants enables them to furnish some supply of nitrogen to such a soil.

Owing to the increased use of commercial fertilizers of late years, and the limited application of barn-yard manure, our soils cannot be supplied with sufficient amounts of organic matter without recourse to green manuring. In early colonial times the farmers had access to leaf-mould and vegetable decay, which were the accumulations of centuries, and the necessity for manures and commercial fertilizers was not so urgent. In order to bring our unremunerative soils back to a condition approaching that of colonial times, and to put them into a condition in which they will become remunerative and bear larger crops, we must follow the teachings of nature, which, as we interpret them, consist in supplying our depleted soils with more organic matter.

POSSIBILITIES FOR FARM FORESTRY IN MASSACHUSETTS.

BY ALLEN CHAMBERLAIN, SECRETARY MASSACHUSETTS FORESTRY ASSOCIATION.

Notwithstanding the innumerable articles which have been printed by the daily and weekly press of the whole country during the past five years on the subject of forestry in general, there still exists in the minds of many only a vague idea of the true meaning of the subject. This misunderstanding cannot be attributed to the fact that agitation in favor of forestry is new to this country, for it has been urged in this State of Massachusetts by individuals and societies for more than one hundred years. The failure to make the proper impression seems to be due to a too general treatment of the subject so far as the country at large is concerned, and in our own State to a too limited propaganda. All this talking has not been entirely in vain, however, for there have been and still are farmers in Massachusetts and in New Hampshire who have applied the science of forestry in part to their woodlands, and with profit to themselves and to their children. But the day of widely applied forestry is only just at hand, and our farmers are beginning to ask how it can affect them and their wood lots. That the farmers are generally becoming interested is the most hopeful sign of the century, so far as this subject is concerned.

Although the subject has been agitated for so long a time, the first general public awakening to it was caused by President Cleveland's proclamation, in February, 1897, by which 21,000,000 acres of government-owned timber lands were set aside as permanent national forest. For a time the people in those western States where these reservations

were established struggled madly to secure their annulment. Instead of abolishing these reservations, the next administration added others. By that time public opinion had changed, on a better understanding of the subject, and those who had clamored loudest against Mr. Cleveland's act were heard petitioning that yet other reserves be established. This was the beginning of a system of national forests, and the whole people believes in it to-day.

About the same time the State of New York began purchasing vast tracts of timber land in the Adirondacks and Catskills, and Pennsylvania soon after followed suit. This was the beginning of State forests in this country. Massachusetts has no such vast forest domains within her borders; nevertheless, she is doing her share in the application of the science at home, but in part for a different purpose.

That we may the better understand what we are doing as a nation and as a State in this matter of forestry, let us examine briefly into the reason for our doing it. Forestry is a science. So, too, is the practice of electricity. The time was when few believed that anything business-like or commercial would develop from electricity. It was regarded as a theoretical science pure and simple. To-day vast capital is employed in promoting the many branches of the electrical business. Forestry also is capable of being made a profitable business. This has been sufficiently proven by the experience of European countries and communities during the last century, and during recent years by some of our own more progressive lumbermen.

One of the reasons why we as a nation have not embarked upon this enterprise earlier, is that we have heretofore had an ample stock of virgin timber to draw upon, and many other more pressing problems to consider and dispose of. When our scientific men called attention to the fact that we were using nearly twice as much timber as our forests could possibly produce, provided even that they were well stocked and skilfully managed (which they were not), and that our farming and manufacturing interests would soon begin to feel the effect of a denudation of the hills which sheltered the source of their water powers, then we began to think deeply and to act as well.

Our great national timber tracts in the west are not to be held as public pleasure grounds pure and simple, as some have supposed. They are to be worked on a business basis, and their mature growth harvested and marketed for the good of the nation. Even if they fail for a time to do more than pay their own running expenses, there will still remain a distinct profit to the nation, in that the water powers rising in the midst of those forests will be insured for all time to the use of the irrigated farms and to the mills of a wide section. To furnish timber and to conserve the water supply is the main purpose of those reserves, and the same is true of the New York and Pennsylvania reservations also. As a secondary consideration, they constitute vast public pleasure and hunting grounds. Of course we have those other reservations, the great national parks like the Yellowstone and Yosemite, which are pleasure grounds pure and simple, and whose timber is not to be considered in a commercial light. These stand in much the same relation to the nation as do the Blue Hills, Middlesex Fells, Mt. Greylock and Mt. Wachusett public reservations to the State of Massachusetts. They protect the water supply of certain areas, and furnish wild recreation grounds for vast numbers of people. These are not forests in the forester's sense of the word, and yet they represent one branch of the science, in that these woodlands are being cared for with a view to improving the native growth, that a perpetual wild forest may be maintained.

But Massachusetts has entered upon yet another piece of important forestry, which has an indirect commercial side. This is the protection of one of our most important harbors and its neighboring town from a slow but certain engulfment in shifting sand. Provincetown, out on the tip of Cape Cod, is the proud possessor of the only good and available harbor between Boston and Martha's Vineyard; but, owing to the improvident cutting of the original growth of trees and beach sod along the eastern side of the cape, the storms have driven in the sand of the Atlantic until it stands to-day in miniature mountains, but moving mountains, over against the town and steadily creeping upon it. To stop this movement of the sand was the forester's work, and the

State for the past five or six years has been working at establishing a plantation of pine and smaller growth along the seaward side, to anchor the sand and prevent further encroachment upon the town. A similar work was undertaken some years ago on the coast of France, and with entire success, and the work at Provincetown has thus far gone on prosperously. This is forestry of a thoroughly legitimate order, although it is not a plan to grow timber for market.

Massachusetts has therefore made a good beginning in State forestry, but it is all purely of a protective nature. Inasmuch as we have no great timber area like that in New York, there is no reason for the State to enter upon the cultivation of commercial timber. The application of this branch of forestry should be left in this State to private enterprise; and it is safe to predict that, if our own citizens do not undertake it, outside capital will eventually come in and begin operations. There is at least one such company established on Massachusetts territory to-day. It controls at present some 5,000 acres in one township, and is negotiating for the purchase of more. It has even been reported on good authority that they hope to buy the whole township. Primarily this company was formed for the establishment of a game preserve; but it is known that they are already planning to start a forest, which they hope to make commercially valuable.

"Why not encourage such foreign capital to come in and do such work?" some one may ask. If they will consider the best interests of Massachusetts, it would surely be wise. But who wants to see acres of trees growing on land that is more valuable for agricultural crops? Forestry does not seek to ruin a country and turn it back from civilization to wilderness; the science of forestry is diametrically opposed to any such practice.

Our problem in Massachusetts is to keep what we have, and to improve it; hold fast to our tillage, and grow good crops thereon; hold on to our wood lots, and improve them; and, finally, make those old barren pastures, too poor to keep a sheep alive, and those low places, too wet for grass, grow marketable wood of some kind.

Let us see for a moment what our woodland represents

to-day. By the census of 1895, our wooded area is given as nearly 1,500,000 acres, and its value as almost $24,000,000. While this is a gain in woodland area in ten years of more than 71,000 acres, its valuation shows a shrinkage of something over $1,300,000 in the same period of time. In thirty years the value of our woodland has increased some $440,000, and the acreage increase shows almost identically the same figures. Judging by the census returns, the character of our woodlands appears to have improved on the whole in the ten years from 1885 to 1895, but the depreciation in value of more than $1,300,000 seems to indicate that further improvement is possible.

The same census shows that we have in permanent pastures, swamps and other waste country some 250,000 acres less than in 1885. That in itself looks promising; but when we compare the values for 1885 with those of 1895, it is seen that there has been a falling off of almost $4,000,000. This would make this land worth more than $15 an acre, which is pretty high for waste country. The loss is not offset by a gain in arable land, for a loss is shown in that class, and with a gain in valuation, notwithstanding. The gain of 71,000 acres in woodland is not enough to balance it. Some of it may have gone into residential property, but still the tremendous loss in valuation remains.

Our farmers have an opportunity to make good this loss by making these lands, which are no better than a burden to-day, yield a revenue to their owners and to the Commonwealth by planting trees upon them.

When it is deemed advisable to plant any part of the farm to trees, there are several points which should be carefully considered before even the variety of tree to be used is thought of. First, it should be determined whether the owner desires to realize from his labor by an actual harvest during his own lifetime, or merely to increase the value of his farm that he may sell it thus improved a few years hence with a promising growth of timber trees upon it, or to make the plantation in the nature of an investment for the benefit of his children. Having settled this phase of the problem in his mind, his next move is to study the character of the soil, to ascertain what varieties of trees it is best adapted

to grow. It would then be well to write to the forester of the United States Department of Agriculture, stating the ultimate purpose in making such a plantation, what the general soil conditions are, and something about the lay of the land, its area, and to what use adjoining lands are put. He will thereby secure the best of professional advice as to his best course, and without charge.

As a rule, it is good policy to make use of native varieties when planting; and, on the whole, it is cheapest to use seedlings rather than seed. There are a few trees other than natives which will do well here under proper soil conditions; and among them may be mentioned the European larch, which is a more rapid grower than white pine, and which makes a fine, straight-grained and light building timber. The western hardy catalpa (*Catalpa speciosa*) is another tree which it is believed has great possibilities in this region. This again is a rapid-growing tree, making good railroad ties, posts, etc., in sixteen years from the seed. It has already been demonstrated by a western railroad that catalpa ties outlast all others, their life in mud ballast being over thirty years. In low, wet places the white willow (*Salix lucida*) is a valuable tree. A growth of eight years makes charcoal stock, and anything up to four inches in diameter is available for the powder mills. White or swamp maple (*Acer dasycarpum*) is another good tree for low ground, and its wood is in demand for last-making. Both the willow and the maple sprout vigorously.

While it is much to be desired that the waste places on the farm should be made to yield a wood crop, it is hoped that the existing wood lot will not be neglected. It is most important that it should be improved and perpetuated. It would be a needless waste of space to enter here upon a discussion of the methods of planting or cutting, since the Federal Department of Agriculture has prepared an excellent little pamphlet of forty-eight pages on these subjects. This pamphlet is known as "Forestry for Farmers," and a copy can be secured by any one who will address a postal card to the Secretary of Agriculture at Washington. Every farmer in Massachusetts should secure a copy, read its pages carefully, and keep it on his shelf for reference when he has

work to do in his wood lot. Another government publication of great value, and which is sold for a nominal sum, is the "Primer of Forestry, Part I." Neither of these works deals in any language which cannot be understood by the average man. Both are written by practical and skilled foresters, and are among the best works on the subject for the use of farmers. The "Forestry for Farmers" tells how trees grow, about soil conditions, rate of growth and reproduction, how to plant a forest, what kinds of trees to use, the best methods of cutting in the wood lot, and something about the economic relation of the wood lot to the farm.

The most valuable woodland growths of our State to-day are doubtless the white pine and the chestnut. There is no trouble in keeping a chestnut growth perpetual, owing to the strong sprouting proclivities of the tree. With pine it is different. Cut a pine lot clean, and a hardwood growth follows. Forestry proves that this is needless. A pine lot can be kept continually in pine, if enough old seed-bearing trees are left in suitable locations, and all fires and cattle kept out. A pine seedling is a very delicate plant, and the trampling of cattle or a light leaf fire will kill it at once.

Again, there is a great deal of white pine in this and in neighboring States that is growing under conditions which are most unsuitable and unprofitable. It is common enough to see an old pasture, for instance, growing up thickly to white pines. Few owners of such growth think of going near it to study the condition of the trees. For the most part they grow up as best they may, and at the end of forty years, say, they are cut and sold for cheap box boards. Where they stand thickly, at the end of the forty years the trunks are small, and covered with dry branches from butt to crown. Where they stand in comparatively open ground, they are larger in diameter, shorter, but covered with limbs, though these are mostly living. Now, every one knows that every limb, whether alive or dead, means a knot in the lumber which runs clear through to the heart; it is equally well known that clear lumber is worth many times more than knotty lumber; but it is not generally known that it is an easy matter to grow clear lumber, and thereby to produce

a more valuable crop than is possible if the trees are left to take care of themselves.

The writer is personally acquainted with two men who have for years made it a practice to take care of their pine lands. One of these men owns timber in Plymouth County, the other in southern New Hampshire, just over the Massachusetts line. In general their methods are alike, but in details of handling they differ. Both recognize the fact that young pines grow best when close together, thus shading and sheltering one another, or when coming up under the protecting wing of a brushy deciduous growth. Both go through their pines once a year, and thin out the poorest specimens, or the brush and sprouts, and thus give the young pines a good chance to push ahead. Both know the value of clear lumber, and take care, as the trees advance, to remove the lower limbs close up against the trunk, so that there remains no stub outside the bark, and consequently insuring clear timber beyond that point. Here is where they differ. The Plymouth County man trims his trees with a knife and thin-bladed axe, beginning when they are, say, five years old. The New Hampshire man waits till his trees are, say, ten years old, and then goes over them with a saw. The Plymouth man secures a greater proportion of clear lumber by beginning when his trees are very young, but the New Hampshire man contends that his timber sells well enough to suit him (and it may be added that he is a keen business man). The thinning process goes on from the first to the last. In cases where seedlings have been planted, it is often worth while to do the thinning for the first year or two with a spade rather than with an axe, especially in the case of fine, thrifty specimens that are crowding equally good ones. Thus many good seedlings can be secured to take the places of the few that die from natural causes, or to set out in new ground. As the trees grow toward maturity, the improvement cuttings can be utilized for firewood, or, if numerous enough, for lumber.

It has been sufficiently demonstrated in practice that this thinning and trimming is not expensive, if done at times when there is little else demanding attention on the farm. A tree can be pruned at any season of the year when it is

most convenient. In the case of the white pine, an exception might be made by those who consider outward appearances somewhat even in the timber lot. A pine trimmed in the spring or early summer will "bleed," and the stem will thereby be badly smeared with pitch. Authorities assert that this "bleeding" does not injure the tree, but it makes an unsightly forest. From August to March is the best time, therefore, to trim the pines; and most farmers will find this convenient for them, inasmuch as it is in the fall and winter that their greatest leisure comes.

A final word should be said concerning one of the most serious hindrances to timber growing, namely, woodland fires. Until this annual evil is checked, it would be folly to invest much money or labor in timber lands. That it can be checked has already been proved by the States of Minnesota and Pennsylvania. Both of these States have been heavy sufferers in the past from forest fires, but the people at length awoke to the need of doing something drastic. Rigid laws were enacted, providing severe penalties for setting fires or for allowing brush fires to escape, and providing officers, who are required under penalty to enforce them. These laws have been enforced, and with marked success. Pennsylvania, for instance, suffered an average annual loss for years of over $1,000,000. Since the passage of their fire law the average has dropped to a few thousand. Massachusetts has laws enough on this subject, but they are not enforced. The woodland of the State is valued at nearly one-third as much as all the farm buildings in the Commonwealth, and yet only a few towns think it wise to enforce the laws which are intended to protect all this property from needless losses.

The best fire law on the Massachusetts statute books is chapter 254 of the Acts of 1897; but, before it can become operative in any town, it must be formally accepted by the voters at a town meeting. This law was passed at the urgent request of some of the Cape Cod towns which had been severe sufferers from fires. Those towns adopted the law at once, enforced compliance with its provisions, and the benefits have been marked. That this law is not more widely accepted must be due to one of two reasons, — either the

people do not generally know of its existence, or they are unwilling to tax themselves for the support of this useful piece of machinery.

If any one doubts the need of seriously grappling with this fire problem, let him but consider the losses which the State sustains yearly from this cause. Our average loss is conservatively estimated at from $100,000 to $150,000. In 1895 nearly $50,000 worth of buildings were destroyed in the path of woodland fires. In 1899 returns were secured on 136 fires in 45 cities and towns, and these it was found burned over an area of 6,960 acres. There were known to have been many other fires throughout the State during that year, but reliable returns could not be secured regarding them. The immediate loss from the 136 fires on standing and corded wood amounted to $58,173, and on buildings which stood in the path of fires to $23,530; this makes a total loss of $81,703. This does not include the cost of labor employed in fighting the fires, which amounted to not less than $5,000.

In 1900 the State Fire Marshal secured official returns from 59 cities and towns, showing 229 woodland fires, with a total present loss, exclusive of labor, amounting to $232,071. This includes the loss on standing and corded wood and on buildings standing in the course of fires.

These present losses do not, however, begin to cover the actual damages. Testimony secured from owners of timber and woodland in various parts of the State shows that even the lightest of leaf fires causes damage to growing trees which cannot be estimated in dollars and cents. It is the general opinion that, while light fires running in the dead and fallen leaves do little injury to old oaks and other thick-barked trees, such fires do kill quantities of valuable white pine seedlings, and they also set back for a year or two young deciduous seedlings. Oak, maple, birch and beech under fifteen years old are easily killed by a moderately hot fire, and much older trees are seriously injured and mature pine even killed by them. A forest will not wholly recover from a severe fire in thirty years. Not only is the growth damaged, but the soil is greatly impoverished by a hot fire. One instance may be cited where a good crop of fifteen-year-old

hard wood was destroyed. It required five years for a new growth to become established, and this succeeding crop was composed of far less valuable varieties than the one destroyed.

It remains for the farmers themselves to say whether they will protect themselves against this annual scourge by adopting and enforcing the laws which have been provided for the purpose. Without some such insurance against fire loss, little enthusiasm can be expected on the subject of forestry.

Bibliography.

The following publications of the United States Department of Agriculture will be found of great value to every farmer who is interested in this subject. A postal card to the Division of Publications, Department of Agriculture, Washington, D. C., will fetch the desired information.

What is Forestry?
Work of the Division of Forestry for the Farmer.
The Practice of Forestry by Private Owners.
Forestry for Farmers.
Relations of Forests to Farms.
Tree Planting in Waste Places on the Farm.
Practical Tree Planting in Operation.
Trees of the United States Important in Forestry.
Forest Influences.
A Primer of Forestry, Part I.
Notes on some Forest Problems.
Measuring the Forest Crop.

BIRDS AS PROTECTORS OF WOODLANDS.*

BY E. H. FORBUSH, ORNITHOLOGIST TO THE BOARD.

The greatest enemy of the forest is man, for there is no devastation of the woodlands which even approximates that which comes from fire or the axe. Against these evils (which are blessings only when well handled) only education and legislation can protect us. We know the injury to the woodlands caused by long droughts, or by cold and storms. From injuries so caused there is no deliverance, neither is there any remedy provided, but the damage from elemental causes usually falls on trees which have passed their age of greatest usefulness, or upon young and sickly specimens. We know that trees are subject to many injuries by animals. Their foliage is eaten by beetles, flies, grubs and caterpillars; their fruit and seeds destroyed by insects, birds and squirrels; their twigs destroyed by borers or cut off by girdlers; their bark eaten by mice, hares and other animals; their trunks and roots attacked by wood borers; even their very life blood, the sap, is sucked out by aphides. Against such injuries, however, nature provides preventives or remedies. Some species of trees have hundreds of insect species feeding upon them. When we consider well the fecundity, voracity and consequent great possibilities for mischief possessed by the trees' enemies, we wonder that trees survive at all. Still, trees spring up and grow apace. In a wooded country a few years' neglect suffices to clothe field or pasture with a growth of bushes and young trees, and in time a wood lot succeeds the cleared land. That trees are able thus to spring up and grow to maturity without man's care is sufficient evidence that they are protected by their natural friends from the too injurious inroads of their natural enemies. Among these friends birds hold the chief place.

* Illustrated by the author.

It is generally believed that there are few birds in deep woods. Travellers have often remarked the scarcity of birds in the forest, and it is true that usually there are fewer birds, both in numbers of species and individuals, in most northern forests than in more open or cultivated lands. Those that live and breed in the deep woods, however, are especially fitted to destroy the trees' enemies, and twice each year, in spring and fall, a great wave of migratory, insect-eating birds that summer in the north and winter near the tropics, passes through the woods of the temperate zone, gleaning insects from the trees as well as from the plants springing from forest floor, from the leaf-mold or from out the very ground.

Here in Massachusetts, in the chill days of March and early April, when sunshine and shadow fleck the lingering snow, in silent woods and along swollen streams the lusty fox sparrow searches for hibernating insects, which only await the warmer sun of April or May to emerge from their hiding-places and lay their eggs upon or attack the trees. He and his companions, the tree sparrow and the junco, soon pass on to the north, making way for the white-throats and thrushes, which continue the good work, to be followed in their turn by other thrushes and towhees. In early April birds are not plentiful in the woods, but the chickadees, woodpeckers, jays, nuthatches and kinglets are doing their part. Later, in the warm days of May, when nature has awakened from her long winter's sleep, when the little light green oak leaves are just opening, when the bright young birch leaves decorate but do not hide the twigs, when every leaflet vies with the flowers in beauty and every branch upholds its grateful offering, when insects which were dormant or sluggish during the earlier days of the year become active in ascending the trees, and when their swarming offspring appear on bud and leaf, then the south wind brings the migratory host of birds which winter near the equator. They sweep through the woods. They encompass the trees. Flight after flight passes along on its way to the north, all gleaning insects as they go. No one who has not watched these birds hour after hour and day after day, who has not listened to their multitudinous notes as night after night they have passed overhead, can realize the numbers that sweep through the

woods in the spring and fall migrations. Those who have watched the flights of wood warblers during the present season cannot but marvel at their vast and constantly changing procession. On May 11 of the present year, at Amesbury, Mass., Blackburnian warblers were seen all through the woods at daybreak. Having come in the previous night, they were not singing, but were busily feeding until seven o'clock. At eight o'clock not one was to be seen. They had passed on, and other species had taken their place.

The great hosts of migratory warblers feed largely on young caterpillars and plant lice, — two of the worst enemies of trees. These birds come at a time when the first broods of these insects appear, and so do yeoman service in preventing their enormous increase. One needs only to know the possibilities in the way of reproduction among the plant lice to appreciate the services of birds in destroying these early broods. Lintner says of one species, — the hop-vine aphis, — that, according to Riley, it has thirteen generations a year, and that, giving the average number of young produced by each female as 100, if every individual should attain maturity and produce its full complement of young, the twelfth brood alone would amount to ten sextillions. "If this brood," says Lintner, "were marshalled in line, ten to the inch, touching one another, the procession would extend to the sun (a space travelled by light in eight minutes), and beyond that to the nearest fixed star (a distance travelled by light in six years), and onward into space beyond the most distant star that the strongest telescope may bring to our view, to a point so inconceivably remote that light would only reach us from it in twenty-five hundred years." It need hardly be said that no such multiplication as this can ever occur in nature; still, the calculation shows the possibilities of great danger to vegetation should any of the forces be withdrawn which hold these insects in check. Dr. Fitch, by a careful enumeration and computation, estimated that several young cherry trees about ten feet in height were each infested by at least 12,000,000 aphides.*

The increase of these creatures is largely controlled by birds, but in greenhouses, where birds cannot go, plant lice

* American Journal Agricultural Science, 1846, p. 282.

are a serious evil, and florists have to combat them with insecticides and fumigation. The value of birds as aphis eaters has been shown by confining them in greenhouses. E. A. Samuels says that three full-grown rose bushes in a greenhouse were infested by some 2,000 plant lice which were all consumed in a few hours by a single titmouse.* Rudolphus Bingham of Camden, N. J., states that he kept a winter garden almost entirely free from plant lice, wasps and flies by confining an indigo bird there.† He also kept a few native sparrows in a greenhouse, and as a result the place suffered very little from insect attacks. After the birds had been introduced he found it unnecessary to fumigate. These experiments determine only that birds will eat aphides when confined with them; but any one who will watch the warblers and other small birds in May among the birch or other woods infested by aphides will be convinced that they take vast numbers from choice. My assistant, Mr. F. H. Mosher, watched a pair of Maryland yellow-throats eating plant lice from the birches in the Middlesex Fells reservation in Malden, May 28, 1898. One of them ate 89 of these tiny insects in one minute, and they continued eating at that rate for forty minutes. Mr. Mosher states that they must have eaten considerably over 7,000 in that time. This seems hardly credible, but Mr. Mosher is a very careful, painstaking and trustworthy witness. He adds that the birds made several other visits to the tree during the forenoon, and continued feeding as at first.

FIG. 1. — Chickadee hunting insects.

Caterpillars are among the worst enemies of trees, and where they are numerous they form at least two-thirds of the food of the warblers. Probably all woodland birds, from hawks, crows and owls down to the tiny titmice, wrens and

* Thirteenth annual report secretary Massachusetts State Board of Agriculture, 1865, p. 94.

† Nineteenth annual report New Jersey State Board of Agriculture, 1891-92, p. 163.

kinglets, feed on smooth-skinned caterpillars, while at least fifty species are now known to feed on the spiny and hairy caterpillars. It is largely due to a lack of native birds that the shade trees in our cities are so overrun with caterpillars. While the imported sparrow keeps down the span worms, it does not check many other pests. When the imported leopard moth appeared in New York and Brooklyn, causing great havoc among the trees in the parks, it was feared that as the insect spread it would become a serious enemy to the trees of the entire country. But I am informed by Dr. J. B. Smith, State entomologist of New Jersey, that this moth is doing little damage in the country districts, where the native birds seem to keep it in check. At first it looked as if the large larvæ would escape the birds, because of their habits. They are borers, beginning life within the small twigs, and when these quarters get too narrow for them, they eat out and crawl down outside to larger twigs. It is then they are taken by many native birds, though the imported sparrows do not appear to check them. Dr. Smith says that the woodpeckers eat the female moths, and probably drag the young larvæ out of the smaller twigs. The American silkworm, the larvæ of *Telea polyphemus*, is one of the largest and most voracious of our caterpillars, and, should it increase as rapidly as the gypsy moth, it would become a fearful pest; but it is noticeable that this and other allied species of great size never reach a destructive height. The principal reason for their scarcity is that they are eagerly eaten by birds. Hawks, owls, goatsuckers, woodpeckers, jays, robins, tanagers, blackbirds and other species capture these large caterpillars. When Mr. Leopold Trouvelot was engaged in raising American silkworms at Medford the robins came from all quarters to destroy them, and gave him more trouble than all other birds combined.

Mr. Trouvelot says that one of these caterpillars will consume in fifty-six days not less than 120 oak leaves, weighing three-fourths of a pound, drinking in the mean time not less than one-half ounce of water, the weight of the food eaten being 86,000 times the weight of the worm on the first day. During this time it has increased in weight 4,140 times. The destructiveness of the species if allowed to increase may be

imagined. Two thousand of these insects were taken by the birds from a small oak in front of his door within a few days. Mr. Trouvelot, speaking of the birds which penetrated into the enclosure in which he was raising the silkworms, quaintly says: "The small ones could go through the meshes and the larger ones through some holes in the old net. So I was obliged to chase them all the day long, as when pursuing them on one side they would fly to the other and quietly feed, until I again reappeared." He expresses the belief that in a state of nature 95 per cent of these insects are destroyed by birds alone.

But this is only one indication of the value of birds in this respect. When settlers first began to plant orchards and establish tree claims on the western prairies, there were few, if any, arboreal birds there, except along the timbered river bottoms. The settlers imported insect pests on young trees. The enemies of tree insects being absent, because the country was destitute of well-grown groves and orchards, the insects increased and over-ran the seedling trees, the larger moths, like the cecropia and the polyphemus, being the worst pests of all, increasing rapidly, eating voraciously and making it almost impossible to raise trees. Dr. Lawrence Bruner, in a paper on insects injurious to tree claims, states that the absence alone of so great a factor as these birds in keeping down and ridding a country of its insect pests soon becomes apparent in the great increase and consequent damage done by these pests. He asserts, also, that as an enemy to tree culture the cecropia has no equal in some portions of the prairie country, and that its large caterpillars often defoliate entire groves, — something unheard of here. Mr. W. C. Colt, who has had experience in raising trees in Dakota, tells me that the caterpillars of this and other large species were terribly destructive there. As groves and orchards became established, however, and arboreal birds spread over the country, these caterpillars were reduced by them to a state of comparative harmlessness.

During the past two summers, 1898 and 1899, much injury has been done to the woods in certain sections of New England by the so-called forest tent caterpillar (*Clisiocampa disstria*). Birds destroy great numbers of these pests, and,

were birds more numerous, there would probably be no great outbreaks such as have occurred in recent years. Dr. E. P. Felt, State entomologist of New York, says that one of the most fruitful methods of keeping this pest in check through its natural enemies will probably be found in encouraging and protecting the native birds known to feed upon it.*

As showing the large numbers of these caterpillars eaten by birds, a few notes from Mr. Mosher's observations will be of interest. A black-billed cuckoo was seen to eat 36 forest tent caterpillars within five minutes. Red-eyed vireos (probably a pair) took 92 forest tent caterpillars from a tree within an hour. They were also eating span worms and other larvæ and plant lice. A male Baltimore oriole went into a tree infested by these caterpillars, where he stayed four minutes, killing 18 caterpillars in that time; coming a little later, he stayed seven minutes, and took 26 caterpillars. A pair of blue jays came to the tree twenty-four times during three hours, taking 2 or 3 caterpillars at each visit.

All through the summer the trees are guarded by the birds. While the white grubs of the May beetle are still in the ground, ere they can emerge to feed on the foliage, the robins, crows, thrashers and blackbirds search them out and destroy them. The sparrows and towhees also search among the dead leaves for caterpillars which crawl on the ground and drop from the trees, and for those which pupate among the litter of the forest floor. Woodpeckers tapping the trunks bring forth injurious ants, bark beetles, wood-boring insects. Creepers, kinglets and nuthatches search the bark and cavities of the trunk and limbs for scale insects, bark lice, borers, bark beetles and the larvæ and pupæ of other insects which hide there. Warblers, thrushes, tanagers, wrens, titmice, vireos, cuckoos and other tree-loving birds pry about among the leaves and branches in search of caterpillars of all sorts. Even the hidden leaf rollers are sought out by the grosbeaks and many other birds, and the gall insects are dragged from their hiding places by the jays and grosbeaks. Titmice get the bud worms and woodpeckers search out the worm which destroys the fruit. When the

* Insects injurious to maple trees, fourth annual report, Commissioners Fisheries, Game and Forests.

span worms, disturbed by the movements of the caterpillar-hunting warblers, vireos and sparrows among leaves and twigs, spin down on their gossamer threads, and so escape one enemy, they are marked by flycatchers sitting on the watch or hovering in the air ready to dart upon them. When the mature insects, gaining wings, attempt to escape by flight, they are snapped up by these same flycatchers, which sit waiting on the outer limbs of the trees; or, escaping these, they are pursued by the swallows and swifts in the upper air. Those whose flight is nocturnal must run the gauntlet of the screech owl, night-hawk and whippoorwill. Thus birds guard the trees as the summer wanes, until the chill of autumn evenings causes the remaining insects to seek winter hiding-places, and warns the birds to begin their southward migrations. Then the tide of bird life turns back, and, passing, leaves the wood in silence, except for the sighing of the branches and the rustle of the falling leaves. In October a few thrushes flit here and there, blue jays mournfully call, a crow caws now and then, but otherwise the woods seem deserted. Still, at this season of the year and all through the winter and early spring months the few birds which remain are accomplishing the greatest good for the forest; for now the development and increase of all insects is arrested, while their destruction by birds goes on. Another point, — the winter birds must subsist largely on the eggs of insects, for many insects pass the winter in that form alone; and the bird that eats these eggs can destroy a hundred times as many insects in this minute, embryonic form, as it could in the summer, after the caterpillars had hatched and grown toward maturity. The jays, titmice, nuthatches and woodpeckers, which remain through the winter in the northern woods, must give at least six months more of service to the trees in Massachusetts than the majority of birds that come here as migrants, or as summer residents only. These birds, with the creepers and kinglets, are especially the guardians of the wood. Millions upon millions of insects and their eggs are destroyed by them during the long winter months. In this work they are assisted to some extent by the winter finches and sparrows.

The following notes from the pen of my friend and co-

worker, Mr. A. H. Kirkland, are of especial interest, from their accurate description of the manner in which eggs of plant lice are destroyed by winter birds: —

Many of our common aphides winter in the egg stage, these eggs being attached to the buds or stalks of the food plants. The large aphis common on willows lays oblong black eggs on the sides of the buds late in the fall. On Jan. 25, 1898, at the Arnold Arboretum, Jamaica Plain, I saw a flock of about half a dozen chickadees feeding on the eggs of this aphis. Some of the birds while feeding came within ten or fifteen feet of the place where I was standing, and I could observe plainly their movements.

The aphis common to the white birch in this region lays great masses of eggs on the buds and twigs. Some trees during the fall of 1897 were so thoroughly covered with these eggs that the natural color of the bark was obscured. This vast quantity of eggs served as a storehouse of food for many of our winter birds, and during the days when the ground was covered with snow several species of seed-eating birds were seen to feed upon them. Throughout the winter the chickadees fed on these eggs. The fact was one of almost daily observation. On March 10, 1898, while on a tramp through the Middlesex Fells, I noticed a large flock of these birds feeding in the white birches that covered the southern exposure of a hill. By entering the brushland in advance of the birds I was soon in the midst of the flock, and, remaining motionless, had an opportunity to observe them feeding upon the masses of the eggs. A few days before this date I saw a downy woodpecker feeding upon the eggs on a large white birch that was partly covered with them. Goldfinches were also common visitors to the infested bushes, especially after the snowstorms. The stomach of one of these birds, taken at 8 A.M., Feb. 3, 1898, contained 2,210 eggs of the white birch aphid. When other food was scarce the English sparrow found these eggs a suitable article of diet, and one of these birds, taken at 4 P.M., Jan. 29, 1898, contained 1,478 aphid eggs.

A plant louse that is common on larches, often to an injurious extent, is *Chermes larcifolia* Fitch. This insect lays great numbers of stalked eggs in April and May, and the young lice resulting feed on the juices of the leaves throughout the summer. At the Bell Rock Cemetery, Malden, April 20, 1898, I saw a flock of over forty goldfinches feeding on the eggs and female lice. The birds began feeding at the top of the trees, worked down to the lower branches, then flew to the top of the next larch and repeated the performance. A few English sparrows also ate the eggs.

During the past winter (1897–98) I have frequently seen chick-

adees feeding upon female canker worm moths, picking them to pieces before eating them. On Nov. 26, 1897, I examined the stomach of a white-breasted nuthatch, and found it to contain 1,629 eggs of the fall canker worm. There were no moth remains in the stomach, and it is evident that the bird gathered these eggs from the trees.

My friend, Mr. C. E. Bailey, writes that on March 28, 1899, a single downy woodpecker made 26 excavations for food between 9.40 A.M. and 12.15 P.M. During this time it climbed over and inspected, in a greater or less degree, 181 trees. Most of these excavations exposed galleries in the trunks or high branches in which ants were hibernating. An examination of the stomach of this bird brought to light 1 spider, 1 beetle (unidentified), 2 larvæ of bark beetles (*Scolytidæ*) and 22 ants, also some partially digested material which could not be identified. At 12.15 the woodpecker was at work thirty-five feet from the ground on the dead end of a broken branch, in which were the channels or galleries of large black ants. The bird had made four openings into these galleries, and in each case had uncovered hibernating black ants. By what sense these motionless insects were discovered in their hidden burrows will perhaps always remain a mystery.

FIG. 2 (reduced two-thirds).—Downy woodpecker and his excavations.

On March 30 a brown creeper was seen to inspect 43 trees in an hour, getting its food from crevices in the bark.

Another downy woodpecker was seen on March 31, 1899, taking the larvæ of beetles from beneath the bark of oak trees. The bird seemed to know the exact spot to drill for each larva, for it always cut a small hole directly over the insect, finding the prey unerringly.

The cut, Fig. 3, gives a view of the outer surface of a section of bark taken from a small oak. From this small piece of bark the bird probably secured at least six of the larvæ that were found in its stomach. The holes, *a*, *b*, *c*, *d*, *e*, *f*, indicate those from which the larvæ were taken.

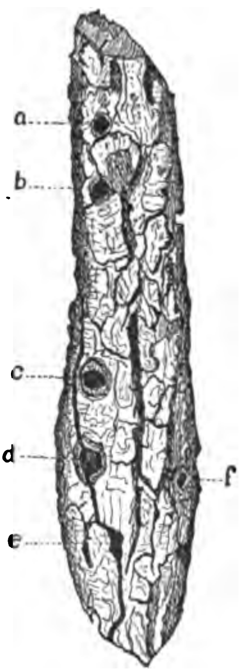

FIG. 3 (reduced two-thirds).— Oak bark pierced by downy woodpecker.

Fig. 4 gives a view of the inner surface of the same piece of bark, showing how true was the stroke of the bird, for its beak, piercing from the outside, went directly to the centre of the burrow where the insect lay entirely hidden from view. The letters *a*, *b*, *c*, *d*, *e*, *f* indicate the holes, showing size and shape, where the bird's beak came through to the inner surface. Seventeen larvæ of bark beetles and 12 ants were found in the bird's stomach.

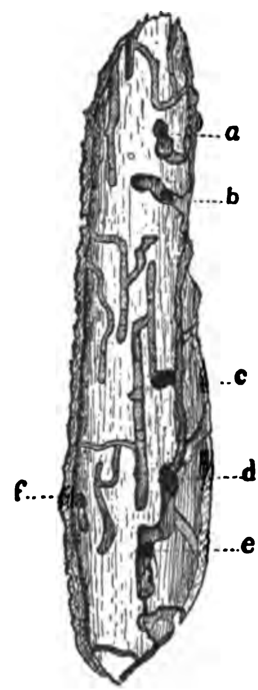

FIG. 4.—Inner surface of the same bark, showing the channels of bark beetles and the woodpecker's perforations.

During the winter the chickadees and jays perform priceless service by destroying quantities of the eggs of such insects as those of the tent caterpillar and canker worm moths. The owls and some of the hawks are useful, not alone in the summer, when they destroy many of the May beetles, larger caterpillars and moths, and keep down the increase of the mice and squirrels, but those that stay through the winter are also useful then by keeping squirrels, mice and hares in check. Hares and mice sometimes do great damage by gnawing the bark or roots of trees. All of these animals

become injurious whenever abnormally numerous. Witness the great plagues of field mice in Norway, and the injury caused in our western plains by the prairie hare or so-called jack-rabbit.

And so, day by day, throughout the year, birds work for the good of the forest. In satisfying their own appetites and providing for their young they guard and protect the trees, which in turn provide them with food and shelter. While feeding on fruit or seed they distribute and sow the seed which shall provide food for future generations of birds. Throughout nature's great plan one organism depends on others, each upon each throughout their numberless interrelations; and he is a wise man who can interfere with this plan, and, by introducing new forces or destroying some of the old, change the scheme without producing disastrous results. Yet we have gone on blindly, destroying our native birds. Gunners shoot them right and left; feather hunters slaughter them; boys with air rifles and shot guns decimate them; a million worthless cats are turned loose to prey upon them; their eggs and young are destroyed at sight by children, cats and dogs; if in pay for their valuable services they take a little fruit or grain, the farmer, who should be their best friend, turns upon them and adds to the slaughter. As a result of all this and more, many species of birds are now rare which were formerly abundant. A few are nearly extinct, and some of the larger species have disappeared from the State. Let birds be encouraged and protected from their enemies, and they will reoccupy their former haunts, and there will then be less necessity for the use of Paris green and other insecticides.

Native Birds useful in Woods.

For the information of those interested in the subject, lists of birds known to destroy some of the worst enemies of trees are given below. The canker worms are reckoned here as among the forest pests, as they frequently attack elms and other trees in the woods, as well as in fields and along roadsides. The tent caterpillar is also included, as it is in some seasons very plentiful in the woods, where it attacks first the wild cherry and afterward the birch, and occasionally other

trees. The gypsy moth is placed first in order, as it is an imported insect, and is considered the most injurious of all. As the Commonwealth of Massachusetts, which has expended more than a million dollars in an attempt to exterminate this insect, has now given up the task as impracticable, and as it is now probably only a question of time before the insect will spread over the country, all birds which may assist in holding it in check assume the utmost importance. The next insect in order, the brown-tail moth, another importation from Europe, bids fair also to become here, as in Europe, a pest of the first class. While this insect does not feed on so many trees and other plants as the gypsy moth, it has already proved itself a serious nuisance here, destructive to fruit, shade, orchard and forest trees. The State Legislature having neglected to provide for the extinction of this insect when it first appeared, it is rapidly spreading, and is now known to have obtained a foothold in Maine and New Hampshire. The tent caterpillars, both the canker worms, the tussock moth, and the white grub or May beetle, are all well-known and destructive native pests, while plant lice are probably known among farmers, gardeners and foresters everywhere. The methods pursued in gaining the information given in the lists below have been described in the crop report for September, 1899.* This work has been supplemented by stomach examinations.

Birds feeding on the Gypsy Moth (Porthetria dispar, Linn.).

The list of birds given in 1896 in the report on the gypsy moth enumerated only 38 species, while 46 are included in the list given below. Several of those not included in the earlier list have been found since to be habitual feeders on this insect. Among these are the scarlet tanager and the Nashville and golden-winged warblers. There is little doubt that this insect as it becomes disseminated will be attacked by other birds, and it is believed that several species not given in the list are now attacking it; but, in view of the general belief that birds do not eat hairy caterpillars, care has been taken to secure the most positive proof before in-

* Birds as destroyers of hairy caterpillars, annual report, Massachusetts State Board of Agriculture, 1899, p. 316.

serting the name of any bird in the list. The list is larger than that given of birds attacking any other of the hairy caterpillars, because more attention has been paid to the enemies of this pest. No doubt as many species of birds may be found attacking other hairy caterpillars.

Yellow-billed cuckoo,
Black-billed cuckoo,
Hairy woodpecker,
Downy woodpecker,
Yellow-bellied sapsucker,
Flicker,
Kingbird,
Great-crested flycatcher,
Phœbe,
Wood pewee,
Least flycatcher,
Blue jay,
Crow,
Red-winged blackbird,
Baltimore oriole,
Bronzed grackle or crow blackbird,
Chipping sparrow,
Song sparrow,
Towhee,
Rose-breasted grosbeak,
Indigo bunting,
English sparrow,
Scarlet tanager,
Red-eyed vireo,
Yellow-throated vireo,
White-eyed vireo,
Black-and-white warbler,
Golden-winged warbler,
Nashville warbler,
Parula warbler,
Yellow warbler,
Chestnut-sided warbler,
Maryland yellow-throat,
Black-throated green warbler,
Oven-bird,
American redstart,
Catbird,
Brown thrasher,
House wren,
White-breasted nuthatch,
Red-breasted nuthatch,
Chickadee,
Wood thrush,
Wilson's thrush,
American robin,
Bluebird.

Birds feeding on the Brown-tail Moth Caterpillar (Euproctis chrysorrhœa, Linn.).

So far only 29 species of birds have been observed to attack the brown-tail moth. All of these, it is believed, eat the caterpillars, but the flycatchers attack mainly the flying moths. Birds appear at times to reduce the initial colonies of these pests to harmless numbers. The English sparrow occasionally eats a few caterpillars or imagos, but appears to spend more than an equal amount of time in driving more useful birds away from the infested trees.

Yellow-billed cuckoo,
Black-billed cuckoo,
Kingbird,
Great-crested flycatcher,
Least flycatcher,
Blue jay,
Crow,
Red-winged blackbird,
Baltimore oriole,
Bronzed grackle or crow blackbird,

Chipping sparrow,
Field sparrow,
Song sparrow,
Rose-breasted grosbeak,
Indigo bunting,
English sparrow,
Scarlet tanager,
Red-eyed vireo,
Yellow-throated vireo,
Warbling vireo,
Golden-winged warbler,
Nashville warbler,
Yellow warbler,
Chestnut-sided warbler,
American redstart,
Catbird,
Chickadee,
Wood thrush,
American robin.

Birds feeding on the Forest Tent Caterpillar (Clisiocampa disstria, Hubn.).

Twenty-five species of birds are now known to attack this insect. In connection with a list of birds given by Dr. Felt as feeding on this caterpillar, he quotes Miss Caroline G. Soule of Brookline to the effect that nuthatches become so absorbed in feeding on masses of these caterpillars that they would allow her to approach and touch them. In our experience, however, the nuthatches seem not particularly fond of these larvæ, but this only illustrates how individuals of the same species acquire different tastes. Our observations have often shown that one individual of a species may reject as food that which another of the same species will devour with avidity. All of the species given, except the English sparrow, feed on the caterpillars. This sparrow, however, catches some of the flying moths. These are no doubt eaten by many birds not in this list.

Yellow-billed cuckoo,
Black-billed cuckoo,
Yellow-bellied sapsucker,
Flicker,
Blue jay,
Crow,
Baltimore oriole,
Bronzed grackle or crow blackbird,
Chipping sparrow,
Towhee,
English sparrow,
Scarlet tanager,
Red-eyed vireo,
Warbling vireo,
White-eyed vireo,
Black-and-white warbler,
Golden-winged warbler,
Yellow warbler,
American redstart,
Catbird,
White-breasted nuthatch,
Chickadee,
Wood thrush,
American robin,
Cedar waxwing.

Birds feeding on the Tent Caterpillar (Clisiocampa americana, Harr.).

We have found by observation and stomach examination that at least 32 species eat the tent caterpillar. Others not on the list probably eat the mature insect, and the pupa is taken from its cocoon and eaten by several. The tent or web seems to be some protection to the caterpillars within it, as few birds have been observed to break open the web and take out the caterpillars. Most birds appear to prefer taking the caterpillars from the twigs, branches and leaves. The crow, blue jay, Baltimore oriole and red-eyed vireo are among those that tear open the web and hale the caterpillars forth.

Yellow-billed cuckoo,
Black-billed cuckoo,
Hairy woodpecker,
Downy woodpecker,
Flicker,
Whippoorwill,
Chimney swift,
Wood pewee,
Blue jay,
Crow,
Red-winged blackbird,
Baltimore oriole,
Bronzed grackle or crow blackbird,
White-throated sparrow,
Chipping sparrow,
Field sparrow,
Towhee,
Rose-breasted grosbeak,
Scarlet tanager,
Red-eyed vireo,
Yellow-throated vireo,
Black-and-white warbler,
Golden-winged warbler,
Nashville warbler,
Parula warbler,
Black-throated blue warbler,
American redstart,
Catbird,
Brown thrasher,
House wren,
Chickadee,
American robin.

Birds which feed on the Canker Worms.

This list of 51 birds which feed on canker worms embraces most of the families and genera of the smaller land birds, which were well represented in the locality and at the time when the observations were made. It is probable that whenever small, smooth-skinned caterpillars become numerous, they are attacked by most species of small land birds in the vicinity, as such caterpillars are everywhere eaten greedily by most of the smaller birds and also used as food for their young.

Yellow-billed cuckoo,
Black-billed cuckoo,
Hairy woodpecker,
Downy woodpecker,
Yellow-bellied sapsucker,
Flicker,
Whippoorwill,
Kingbird,
Crested flycatcher,
Phœbe,
Olive-sided flycatcher,
Wood pewee,
Least flycatcher,
Blue jay,
Crow,
Bobolink,
Red-winged blackbird,
Baltimore oriole,
Bronzed grackle or crow-blackbird,
American goldfinch,
Chipping sparrow,
Field sparrow,
Song sparrow,
Towhee,
American robin,
Rose-breasted grosbeak,
Indigo bunting,
English sparrow,
Scarlet tanager,
Red-eyed vireo,
Yellow-throated vireo,
Warbling vireo,
White-eyed vireo,
Black-and-white warbler,
Golden-winged warbler,
Nashville warbler,
Parula warbler,
Yellow warbler,
Magnolia warbler,
Chestnut-sided warbler,
Maryland yellow-throat,
Black-throated green warbler,
American redstart,
Catbird,
Brown thrasher,
House wren,
White-breasted nuthatch,
Chickadee,
Wood thrush,
Bluebird,
Cedar waxwing.

Birds feeding on the White-marked Tussock Moth (Orgyia leucostigma).

Probably all the birds which feed upon the other hairy caterpillars feed also upon this, but, as the opportunity for observing this species has been limited, the list is given for what it is worth. This species has become very destructive to city shade trees since the introduction of the English sparrow, which, eating few of these insects itself, has driven out the native birds which formerly fed upon the caterpillars. It is interesting to note that of late, in some parts of eastern Massachusetts at least, the sparrow is not so obnoxious as during the years immediately succeeding its introduction and increase, and that a few of the native birds are returning to their old breeding place. This may result in checking the ravages of the tussock moth, which does little damage to orchards, shade trees or woodlands where sparrows are scarce and native birds plenty.

Yellow-billed cuckoo,
Black-billed cuckoo,
Whippoorwill,
Chimney swift,
Phœbe,
Blue jay,
Baltimore oriole,
Robin,
English sparrow.

Birds feeding on the May Beetle or its Larva, the White Grub (Genus Lachnosterna).

As the white grubs live in the ground, they probably are not eaten by many birds except such as, like the robin and blackbird, follow the plow. It is this grub that eats the grass roots in lawns and fields, thereby destroying the turf, sometimes in great patches. Crows, robins and blackbirds know where to find these larvæ and how to unearth them. The mature insect, or May beetle, feeds on the foliage of the trees and flies in the night. It is then captured on the wing by owls and whippoorwills. Hawks also find them occasionally, and the omnivorous crows and jays destroy many more.

Sparrow hawk,
Screech owl,
Flicker,
Whippoorwill,
Night hawk,
Blue jay,
Crow,
Kingbird,
Red-winged blackbird,
Bronzed grackle or crow blackbird,
Brown thrasher,
American robin.

Birds feeding on Plant Lice (Aphidæ).

Most of the following birds feed largely on the aphides which infest the gray birch and other forest trees. Most warblers and the indigo bird are particularly active in this respect. The chickadee and the redstart are also among the most useful species. The swifts and smaller flycatchers catch many of the flying imagos. No doubt this is also true of the swallows, although we have not yet observed swallows feeding on these insects. Probably most of the smaller birds feed upon aphides when they are plentiful, but it is not likely that the larger species often seek out such minute insects. The woodpeckers which eat ants, especially the flicker and downy woodpecker, also eat aphides.

Downy woodpecker,
Flicker,
Chimney swift,
Ruby-throated humming bird,
Wood pewee,
Least flycatcher,

Purple finch,
Red-winged blackbird,
Baltimore oriole,
American goldfinch,
Chipping sparrow,
Field sparrow,
Bobolink,
Towhee,
Rose-breasted grosbeak,
Indigo bunting,
Chickadee,
Scarlet tanager,
Red-eyed vireo,
Yellow-throated vireo,
Black-and-white warbler,
Myrtle warbler,
Parula warbler,
Yellow warbler,
Black-throated blue warbler,
Magnolia warbler,
Chestnut-sided warbler,
Maryland yellow-throat,
Black-throated green warbler,
Oven bird,
American redstart,
Catbird,
White-breasted nuthatch,
American robin.

A glance over the list of birds given above as feeding on the different species of caterpillars will show that some of the birds which are believed by many people to be harmful occur in all these lists. The crow eats many caterpillars and more pupæ. The despised jay, which certainly may do much harm by destroying the eggs and young of smaller birds, is one of the most valuable birds we have in some respects, being a most persistent hunter of the caterpillars, pupæ and eggs of some of the most injurious moths. The oriole, which has a taste for fruit, is a gourmand for caterpillars, and the robin and catbird, much decried by fruit growers, feed on nearly all species of injurious caterpillars of the orchard or woodland. The cuckoos are always and everywhere present with the caterpillars, and by many are believed to head the list of caterpillar destroyers; but in woodlands there are no birds more useful in this respect than the beautiful scarlet tanagers or the busy chickadees. Of all the warblers the redstart seems to be the most indefatigable in pursuit of caterpillars, capturing even the most repugnant species. The lists of birds feeding on the different species are not believed to be complete by any means. Most of them probably attack the hairy and spiny species, the smaller birds taking them mainly when the caterpillars are small and the larger birds when they grow larger.

Injury done by Birds to Woodlands.

There can be no doubt that some slight injury may be done to the trees by birds. The grosbeaks and the purple finches eat buds and blossoms, grouse feed largely on young buds, crows and jays eat nuts, crossbills take the seed and buds from coniferous trees, and woodpeckers sometimes bore into sound trees; but the injury done is so slight, compared with the benefits conferred by birds in protecting trees from their enemies and in distributing and planting seeds, that it need hardly be considered in making up the account. It is now said in favor of the much-abused sapsucker, that it is the perforations made by its beak which produce much of the appearance called "birdseye" in the maple. This greatly increases the value of this tree for timber use. Forest birds appear to have been especially designed to maintain that balance of forces in the forest which is essential to its preservation, and we may well fear that without their assistance profitable forestry would be impossible. In this matter there is no higher authority than the distinguished entomologist, Prof. S. A. Forbes of Illinois, who says that estimates of the average number of insects per square yard in that State give ten thousand per acre for the entire area, and that if on this basis the operations of birds were to be suspended entirely, the entire State in seven years would be carpeted with insects one to the square inch. This would certainly happen unless the insects were checked by some providential means. Professor Forbes says that this is intended only as an illustration, and not as a prediction of the consequences of the total destruction of birds, which he says would not be so simple, but apparently fully as grave. He also estimates that, should the people of the State succeed in taking measures which would increase by so much as one per cent the efficiency of the birds of the State as insect police, the effect would be to save to the agriculturists of the State $76,000 per year; but he regards five times this amount as a very modest estimate, for he says the figures on which his estimates are made, "will be regarded by most naturalists as absurdly low." *

* Bulletin No. 3, Illinois State Laboratory Natural History, November, 1880, p. 81.

How to increase the Number of Birds useful in Woodlands.

Some practical lessons have been learned from the study of the food of the wood birds. As birds go where they find food most abundant, many birds of the swamp, field and orchard go from their usual haunts, one-half mile or more, to the woods to feed on insects plentiful there. Thus the bobolink in the meadow goes to the woods for aphides, and the oriole in the orchard and the blackbird in the marsh go there for caterpillars. On the other hand, the chickadee, blue jay, tanager and the warblers go from the woods to the orchards and gardens for caterpillars. In an orchard near the woods we noticed that the wood birds came frequently to those trees nearest the woods, and, by adding their work to that of those living in the orchard, soon cleared the canker worms from the trees nearest the woods.

All our experience thus far goes to show that a well-watered country, where the woodland is kept mainly in detached patches, with the rest of the land more open, much of it well cultivated, with an occasional marsh or swamp, is best calculated to encourage the increase of the largest numbers of species of birds. In such a country vegetation should therefore receive better protection from birds than in any other. In view of these facts, it is possible for a man buying only from thirty to one hundred acres of land to so select his land and control the growth of vegetation upon it as to obtain the conditions requisite to secure an abundance and variety of birds. The first requisite to attract birds is a quantity of suitable food. To provide this, a diversity of vegetation is desirable. This provides not only a variety of fruit and seeds, but furnishes food for a large variety of insects, which will attract the birds. It is especially desirable to have both wild and cultivated cherries and grapes; and, if the birds take too large a proportion of the cultivated species, the earlier wild berries, like the Russian mulberry and the shadberry, should be planted, to draw the birds' attention from the cultivated fruit. Winter food may be furnished birds by planting mountain ash, sumach, bayberry and other berries, which cling to the trees or shrubs bearing

them during the winter months. The winter birds may be induced to remain in some numbers by hanging bones, suet or portions of any carcass in sheltered places on the trees. These will furnish food for them when the trees are covered with ice, and will keep them in the neighborhood during the coldest weather. Sunflower seeds, broken nuts, hay seed and grain will attract winter birds.

Having secured food, the birds must have shelter from the elements and their enemies. This may be provided by planting thick evergreen trees in groups, and allowing a deciduous thicket here and there. Nesting boxes should be provided for those birds which will use them, and such boxes will shelter many a bird from winter storms. Nesting material, such as straw, feathers, waste string, etc., should be hung upon limbs during the nesting season. It will soon be utilized. Having made a locality attractive to birds, they must be protected and fostered. Birds soon learn to love a place where they receive a measure of protection from their enemies. We may protect them: —

1. By doing away with cats, so far as possible.
2. By stopping promiscuous gunning.
3. By suppressing birds'-egging boys.
4. By keeping hawks, crows and jays within bounds.

It is well not only to have a variety of trees in your woodland, but also to have portions of it in different stages of growth. A small patch of ground covered with young sprouts furnishes a desirable breeding place for such birds as the indigo bird, brown thrasher, towhee and several warblers, all of which may be very useful in adjoining woodland. If each farm, wooded or otherwise, could be ideally situated and cultivated, with the protection and accommodation of birds always in view, it is doubtful if Paris green and other insecticides would find a ready market in this Commonwealth, except, perhaps, in such cases as that of the gypsy moth, where man disturbs the balance of nature by introducing a new pest from a foreign shore.

SOME INSECTS INJURING MARKET-GARDEN CROPS.

BY DR. H. T. FERNALD, PROFESSOR OF ENTOMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

Market gardening in Massachusetts is an important industry. Created by the growth of cities, it must increase as they do, in order to supply their inhabitants with the vegetable necessities of life. The successful market gardener is but a short distance from his market, and, in consequence, one of the first indications of nearness to the city a traveller sees on approaching it is a marked increase in the amount of cultivated land and of green-houses. In fact, the market gardens supplying a city surround it in a broad and often almost continuous belt.

The continuous acreage of crops thus produced is directly favorable to the rapid increase of those insects which attack the different kinds of market garden crops, and, as this industry grows larger, we must expect an increased amount of injury from insect pests. Some of the more common of these and the most successful methods for preventing loss by them are here considered.

THE ASPARAGUS BEETLE (*Crioceris asparagi* Linn.).

This too familiar insect was introduced into New York from Europe about 1856, and is now generally distributed over the eastern United States. It passes the winter as an adult beetle, hiding in any protected place. In the spring, about the time the asparagus begins to appear above ground, the beetles leave their hiding-places and lay their eggs on the young shoots of the plant. The eggs are quite large, brown in color, and attached by one end to the plant. They are laid separately, but often quite close together in rows, and when abundant are very noticeable on the asparagus tops. They hatch in from three to eight days, producing little gray

"grubs" with black heads. Each grub feeds until full grown, which takes from ten days to two weeks, after which it leaves the plant, enters the ground and forms a small, rounded cocoon, within which it remains quiet for about a week, during which time the structure is changing to that of the adult beetle. When this change is completed the beetle escapes to feed, mate, and lay eggs for the next brood.

FIG. 1.—The asparagus beetle: *a*, adult beetle; the line beside it shows the real length of the beetle. On the right a branch of asparagus, showing eggs, grubs and beetles, natural size; also an asparagus tip with eggs, and places eaten out. (*From Chittenden, Yearbook, Department of Agriculture, 1896.*)

This brood has the same history as the last, and it is probable that a third brood is produced during the year, before cold weather drives the beetles into their winter quarters.

The adult beetle is rather less than a quarter of an inch long, with a black head, red thorax, and yellow and dark-blue wing covers, the blue forming a stripe along the middle

of the back, crossed near its middle by another of the same color and by a similar one near the hinder end of the body. Along the sides of the back the color becomes reddish.

Injuries and Treatment.

Injury to asparagus is caused both by the grub and the adult beetle feeding upon the shoots intended for market, and also upon the full-grown plants.

For beds where cutting is done, a few shoots left here and there to serve as traps will attract the beetles to them if the other shoots are kept cut as fast as they grow to market size. The trap shoots should be cut about once a week and destroyed, others being then allowed to take their places. If this be continued for four or five weeks the egg supply of the beetles which winter over will be about exhausted, and if no young have found a chance to develop on volunteer asparagus near, the danger of damage from the later broods of the season will be greatly reduced.

In the case of seed beds, dusting with fresh, air-slaked lime while the dew is on is quite effective, as the lime kills every grub it touches. That it is only those grubs which are touched by the lime which are killed, however, should be remembered by those who use this method. Allowing chickens to run in the asparagus beds is advantageous, as these feed freely upon the insects. Cutting down and burning the seed stems two or three times a year is also a good practice, and is now considered not to be injurious to the plant. Finally, several kinds of insects prey upon the asparagus beetle, and aid the grower to keep this pest in check.

THE IMPORTED CABBAGE WORM (*Pieris rapæ* Schr.).

This insect, like the asparagus beetle, is a native of Europe, and made its appearance in this country near Quebec about 1859, since which time it has spread over nearly the entire United States.

The insect passes the winter as a brown chrysalis, attached to some board, fence rail or other object. In the spring the chrysalis bursts open, setting free the white butterfly so common around cabbage fields in summer; and as soon as the cabbages are set out the butterflies begin to lay their eggs on the leaves, one in a place. The eggs are rather smaller than

the head of a pin, pale yellow at first, but darker after a few days. They hatch in about a week, and the little caterpillars which come from them at once begin to feed on the leaves. At first pale yellow, the caterpillar as it grows becomes velvety green, and when full grown is more than an inch long.

FIG. 2.—Imported cabbage worm butterfly: male and female.

It now crawls to some protected place, where it changes to the chrysalis form, — the same as that in which the winter is passed, — and becomes quiet while the internal organs of the caterpillar are being built over into those of the adult butterfly. When these changes have been completed the chrysalis bursts open and the adult butterfly appears, and egg-laying for another brood of caterpillars now begins. During the year there are three broods of these insects in Massachusetts, the winter being passed in the chrysalis stage.

Treatment.

Several methods may be used for controlling this insect. Hot water applied at about 130° will kill the caterpillars usually without injuring the plants, but the disadvantage of this treatment upon a large scale is evident.

FIG. 3.—Imported cabbage worm: *a*, full-grown caterpillar; *b*, chrysalis.

Probably the best method to use is that of spraying with Paris green or arsenate of lead, as these poisons are very destructive to the caterpillars and without danger to the consumer, unless the spraying be done with extreme carelessness and shortly before the heads are cut. There are several reasons why this treatment is not dangerous. The head of the cabbage forms from within, only the very outermost leaves being at any time exposed to the poison, and these are removed in trimming the head for market. Then, too, the poison is chiefly needed

on the outside leaves of the plant, where most of the caterpillars occur, and these leaves are never cut with the head. Chemical analysis of heads heavily sprayed one week before cutting showed that not a trace of arsenic remained. Finally, if spraying be carefully done when the caterpillars first appear in spring and followed up until the head appears, the insect will in all probability be so reduced in numbers that spraying after the head is a quarter grown will be unnecessary, thus removing the last possibility of danger.

This treatment for the cabbage worm is the usual one among some of the largest market gardeners in the country, and no case of arsenical poisoning from eating cabbage treated in this way has ever been reported.

Other substances, such as alum, copperas and saltpetre, have been recommended for use against this insect, but are of no value.

Recently a new treatment has been brought forward by the New York Agricultural Experiment Station, as being better than that recommended above. The material used is known as the resin-lime mixture, and is prepared as follows: —

Stock solution: —

Pulverized resin,	5 pounds.
Concentrated lye,	1 pound.
Fish or any cheap animal oil, except tallow,	1 pint.
Water,	5 gallons.

Place the oil, resin and one gallon of hot water in an iron kettle; heat till the resin is softened, then carefully add the solution of concentrated lye (prepared by the directions for making hard soap always given on the can); stir the mixture and add the other four gallons of water, hot; now boil till the mixture will unite with cold water and make a clear, amber-colored liquid; now add water enough to make up five gallons.

With this as a stock solution, to spray, take: —

Resin lime prepared as above,	1 gallon.
Water,	16 gallons.
Milk of lime,	3 gallons.
Paris green,	1-4 pound.

Bring these together in the order in which they are named, adding the Paris green last, stir thoroughly, and spray the plants. Do not prepare the spraying solution mixture, however, till ready to use it, as it settles on standing.

This treatment has been used with good success, and with reference to it the following statements are made: first, that by it late cabbage and cauliflower can be protected from the attacks of the cabbage worm and cabbage looper by two sprayings; second, that in the case of cabbage the yield can be increased sixty to one hundred per cent; third, that the cost per acre will depend on the number of acres sprayed, the cost of spraying ten acres twice being twenty dollars; fourth, that the mixture must not be applied to cabbage after the heads are two-thirds grown, nor to cauliflower after the "flower" appears; fifth, that only skilled workmen should be permitted to spray cauliflower.

In view of the amount of work necessary to prepare this mixture, and the amount of care necessary, as indicated by these last two statements, it becomes questionable whether the advantage gained by using it — a more thorough adherence of the spray to the leaves — is sufficient to pay for the extra expense and trouble. In any case, it is most likely to be of value where the acreage of cabbage is very large.

The Squash Bug (*Anasa tristis* DeG.).

The squash bug is a familiar insect in this country on squashes, melons and other cucurbits. The adult bugs pass the winter in any protected places they may find, and in the spring, after the squashes are well up, lay their eggs on the under side of the leaves. The eggs are light reddish-brown in color, and very noticeable on the leaves. They hatch in a little more than a week, producing small green-and-black young, somewhat resembling the adult, but without wings. These young keep quite close together on the under side of the leaves at first, but before long work toward the stems, all the time sucking the juices from the plant. They feed in this way and grow for about a month, the insects changing in appearance from time to time as they throw

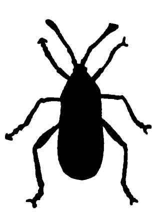

Fig. 4. — Squash bug: adult bug, natural size.

off their outgrown skins, till finally, after the last of these molts, the changes brought about in this way produce the full-grown adult bugs, which proceed to lay eggs for a second brood. These develop in a similar manner, and many of this brood have become adult by the time cold weather approaches, when they leave the plants to seek protected places in which to pass the winter.

Treatment.

This insect does not lend itself readily to treatment. No stomach poison is of any use, as both the young and adult only suck the juices of the plant, and contact poisons such as kerosene fail to kill any except the youngest, unless used so strong as to destroy the vines. Under these circumstances, other methods must be resorted to.

It is evident that, if all the bugs which pass the winter could be destroyed, no spring brood could be possible. As to do this is impracticable, however, efforts should be made to reduce their numbers as much as possible. At all times, but particularly when the nights begin to grow cool in the fall, these insects tend to leave the plants towards dark each evening, and seek protection under fallen leaves, sticks, pieces of board, etc., on the ground. If shingles or pieces of bark be placed near the plants at such times, an early visit in the morning will show many thus collected, where it is easy to kill them. Burning the vines as soon as the crop has been gathered, and clean cultivation, reducing the number of places where protection during the winter may be found, also aid in reducing the number of these pests; while a frequent examination of the under side of the leaves of the plants in June and the destruction by hand of all eggs and young found will prove to be of sufficient value to more than pay for the time required to do this.

Other methods which are of value are: the protection of young plants by coverings, if the bugs appear while the plants are still small; applying land plaster well soaked with turpentine or kerosene to the ground near the stems; planting an excess of seed, and forcing the rapid growth of the plant by fertilizers. All of these are of value, but unfortunately no one of the methods here suggested can be relied upon alone to accomplish the destruction desired.

THE SQUASH-VINE BORER (*Melittia satyriniformis* Hbn.).

The presence of this pest to squash growers is easily recognized by the sudden wilting and dying of the squash leaves during July. Its work is so rapid that frequently the wilting and death of the plants is the first indication of its presence, when it is not a familiar insect to the market gardener.

The squash-vine borer passes the winter in the ground, inside a silken cocoon coated on the outside with particles of dirt. The adult moths which come from these cocoons appear around the plants during the first two weeks in July, in Massachusetts (Harris), and proceed to lay their eggs on different parts of the vines, though the stems are preferred for that purpose.

A female moth may lay over two hundred eggs scattered about in this way, and from them little caterpillars will hatch in from one to two weeks and begin to bore through the stems. Feeding inside the plant, after four weeks or more the caterpillar becomes full grown, whereupon it leaves the stem and burrows down into the ground for two or three inches, where it forms a cocoon within which to pass the winter. In Massachusetts there is but one brood each year. Further south, however, a tendency to produce two broods is evident, and in the Gulf States there are doubtless two full broods.

Treatment.

This would be an easy insect to destroy if the caterpillar fed on the outside of the plant, where some arsenical poison could be placed. Working where it does, however, this method of treatment is not available, and others must be employed instead, no one of which should be relied upon alone, but all be used together.

Fall harrowing of the fields where squashes have been grown during the summer is very effective. This brings the cocoons up from where the insects had placed themselves to the surface, where they are exposed to freezing and thawing during the winter. This, followed by plowing in spring to a depth of more than six inches, will destroy many of the insects.

Good results are also obtained by planting a few summer

squashes, such as cymblins or crooknecks, as early as possible, before the main crop, and between the rows which they are to occupy. Such trap plants attract most of the borers, which leave the later varieties comparatively unmolested. Of course as soon as the crop from these trap plants has been gathered, or when the ground they occupy is needed (if later than the last of July), the vines should be raked up and burned, to destroy any eggs or caterpillars they may contain.

When the borers have once attacked a vine, nothing better than cutting them out is available. If the vines be watched during July, the presence of borers is soon shown by the presence of the yellowish, powdery excrement of the caterpillars, which is forced out from the stem to the ground beneath. When such traces of the presence of borers are found, the stem of the plant should be split lengthwise and the borers be taken out and killed, after which the split should be covered with dirt to aid in healing. If the plants have been induced to throw out roots at different points along the stems, by covering them with a little earth at intervals as they grow, the injury caused by splitting the stems to get out the borers is greatly lessened.

Catching and destroying the moths as they fly about the plants has also been practised in some places, with good success.

Besides the squash, the pumpkin, gourd, muskmelon and cucumber are sometimes attacked by this insect.

STRIPED CUCUMBER BEETLE (*Diabrotica vittata* Fab.).

This insect is a general nuisance over the greater part of the United States. The black and yellow stripes along its back make it very noticeable, while the injury it causes is frequently so great as to almost prevent the raising of cucumbers at all.

About the time the young cucumber plants are just appearing above ground, and frequently even earlier, the beetles leave the hiding-places in which they have passed the winter, and gather about the plants. Not satisfied to wait for these to reach the surface, they often burrow into the ground to meet them, and begin feeding, while as soon as the leaves

appear they gather upon them and upon the stem, which is often cut completely off by the insects. Later, older plants are injured by the beetles, while the young are at work at the roots.

The eggs of the beetle appear to be placed on the stalks of the plants, just below the surface of the ground, and after a time each hatches, producing a little slender, worm-like form, which feeds on the cucumber roots and other parts of the plant which touch the ground till full grown, when it is a little more than a quarter of an inch long. After attaining full size the grub changes in the ground into a quiet pupa, which does no feeding and which remains in this condition from one to two weeks, according as the weather is warm or cold. When this period ends, the outside shell of the pupa bursts, setting free the adult beetle, which proceeds to lay eggs for a second brood.

Just how many broods occur in Massachusetts is not known, but there are at least two and possibly three each year.

Treatment.

No entirely successful method for holding this insect in check has as yet been found. In several ways, however, their ravages may be lessened at small expense. Where practicable, covering the hills with netting before the plants appear is of value, as by the time the plants are too large for the nets they have attained a size sufficient to enable them to withstand the injuries caused by insects, better than those just starting. A convenient form of netting cover is made by taking two pieces of board about six inches wide, and long enough to reach the plants of the hill. To the middle of each board nail a pointed piece of lath, in such a way that when the lath is driven into the ground the board will stand on edge and form one side of a box. Two such pieces may be placed at any desired distance apart, and cheese cloth be tacked on so as to form the top and the other two sides of the box. The chief advantage of such boxes is that on putting them away, at the end of their usefulness, very little space is needed in which to stow them. While in use the earth should be so packed against the box as to leave no space for the beetles to crawl under and thus reach the plants.

Another treatment is to dust the plants while the dew is yet on with a mixture of Paris green, one pound, and plaster or flour, seventy-five pounds, or else with air-slaked lime.

As tobacco appears to be disagreeable to these insects, considerable success has been obtained by applying tobacco dust freely to the ground around the stems of the plants, and renewing the application after every rain.

The cucumber beetle feeds on the squash and melon also, and, if a few squashes be planted early around the edges of the cucumber field, the insect will usually devote most of its attention to them. Spraying cucumber plants with Bordeaux mixture, once as soon as the seed leaves appear, again when the third true leaf develops, and lastly when the plants begin to run, not only makes the plants distasteful to the cucumber beetle, but to flea beetles, and protects them from various diseases to which they are subject.

Root Maggots.

Under this head may be included the onion maggot, cabbage root maggot, turnip root maggot, etc.

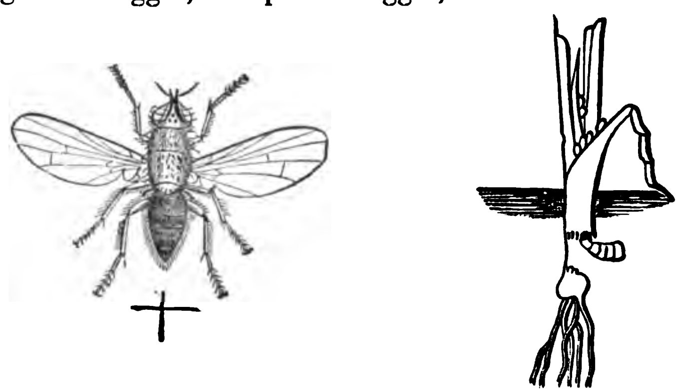

Fig. 5. — Onion maggot; adult fly at left; crossed lines below, showing natural size. Onion plant at right, showing eggs of fly, and maggot working on stem below level of ground.

The adults of these maggots are flies, somewhat smaller than the house fly, which appear in spring and lay their eggs

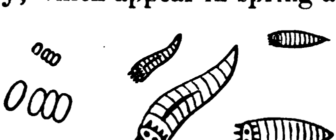

Fig. 6. — Eggs of onion maggot, natural size and enlarged, at left; maggot, natural size and enlarged, in centre; pupa, natural size and enlarged, at right.

on the roots of the young plants. These eggs are smooth, white, and large enough to be seen by the eye. Upon hatching, the little maggots they produce burrow into the stem, root or bulb of the plant, often causing a serious amount of damage. After feeding until full grown, the maggots leave the plant and become quiet pupæ for a time, after which the adult flies escape from them to lay eggs for another brood, of which there are two and perhaps more each year of the kinds here considered.

Treatment.

Many methods have been suggested for checking the ravages of these pests, but only a few are of any value. Protection from the cabbage root maggot may be obtained by the use of tar paper cut to encircle the stems of the plants when these are set out, but the cost of preparing and applying the pieces reduces the value of this method. Before the appearance of the maggots the use of carbolic acid emulsion has been strongly recommended. To prepare this, a pound of hard soap or a quart of soft soap should be dissolved in a gallon of boiling water. Into this pour a pint of crude carbolic acid, and stir until an emulsion is thoroughly formed. To treat the plants, one quart of this, mixed with about thirty quarts of water, will give the required strength. In applying this emulsion, begin the day after the plants have been set out, or, if raised from seed, a day or two before they come up, thoroughly moistening the ground close to each plant with it, and particularly the stems just below the level of the ground, in the case of plants which have been set out. The object of this is to kill every egg and maggot present by actual contact with the emulsion. This treatment should be repeated every week or ten days till about the first of June. "Whoever has tried this emulsion thoroughly, reports success" (Slingerland).

Another and apparently equally successful treatment is by the use of carbon disulphide. To apply this properly, an apparatus such as the McGowan injector is necessary. In using this, push the tip of the injector into the ground three or four inches away from the plant, and run it obliquely down to a point just below the roots; then force about a teaspoonful of the carbon disulphide out of the injector into the

ground, remove the injector and close up the hole with earth pressed down by the foot. This treatment usually needs to be made but once, when the maggots first appear, but would probably be more effective with cabbage and cauliflower than with onions, turnips and radishes, where the carbolic acid emulsion treatment is preferable.

Looking for and crushing the eggs and maggots by hand is also highly recommended, where labor is cheap.

Flea Beetles.

Flea beetles of several kinds are often present in destructive abundance on various plants early in spring. They feed on the tissues, making little holes, and when disturbed take sudden leaps which make it difficult to capture them. The young of these insects are stem and leaf miners, but rarely do sufficient damage to require treatment. For the beetles themselves, spraying the plants attacked, with Paris green, arsenate of lead or any of the stomach poisons is usually entirely effective; though, as various plant diseases often begin at the holes made by these insects, it is generally better to use Bordeaux mixture with a little of the poison added, as Bordeaux mixture appears to be successful against flea beetles as well as being a fungicide.

Cut Worms.

Under the name "cut worms" are included the caterpillars of a large number of kinds of moths, which hide in the ground during the daytime and feed at night.

In cases where these pests are known to be abundant in sod land which is to be cultivated, it is advisable to plow quite early in the fall, and apply the potash which is to be used at this time, kainit being strongly recommended by some writers as probably the best form of fertilizer to use for this purpose, as it is objectionable to the insects.

Cut worms can also be destroyed by the use of traps. To prepare these, spray a small piece of clover or any juicy plant with one of the stomach poisons (one pound of the poison to fifty gallons of water), and then mow it close and spread this poisoned food in little heaps here and there over the field, which should be ready for planting. The cut

worms, finding nothing else to feed on, will eat this poisoned food, and a large proportion will be destroyed.

Later in the season, if cut worms appear after the crop is up, protection from their ravages may be secured by mixing one pound of Paris green with fifty pounds of bran. When these are thoroughly mixed, add water and a little molasses till the whole is about like dough. A tablespoonful at the base of each plant is more attractive to the cut worm than the plant itself, and ten pounds should be sufficient to protect about an acre of potatoes or other crop planted in that way. Care, however, should be taken that fowls and other animals likely to feed on this poisoned food be kept away from it while it is exposed.

This method should also be successful where cut worms are troublesome in greenhouses.

POULTRY KEEPING ON THE FARM.

BY ARTHUR A. BRIGHAM, PH.D., KINGSTON, R. I.

When requested to write "an article that will give hints to beginners and be a help to those who are about starting or thinking of starting in poultry and egg production," my thoughts immediately went back to some of the experiences of my boyhood days on the old farm in Massachusetts. My memory recalls very vividly how one of my attempts to combine horticulture and poultry culture was brought to a sorrowful end, because of rats. As an ambitious young gardener, I had constructed a hot-bed, made two sashes to fit it, and had woven of rye straw a thick mat to cover the whole during cold nights. My early farming under glass prospered, and the plants had been transplanted to the open garden, where they were all, with the exception of the cucumbers, thriving finely. A severe frost one night destroyed the cucumbers completely, thereby teaching the young gardener a seasonable lesson, and perhaps saving several members of the family from the dangers of "summer complaint" later.

The early hatched chickens were doing finely in their regular quarters. A neighbor had that spring obtained some nice Buff Cochin fowls, and later in the season kindly furnished me with a sitting of their eggs. These were given to the care of a motherly sitting hen, and in due time four little golden puff-balls showed themselves. Where to place the yellow-feathered treasures was a puzzle, until the empty hot-bed was thought of as just the place to keep them safe and happy. Here for several days they flourished, to the great satisfaction of their young owner; but pride goes before a fall. One day the four pretty creatures were found stark dead. The youthful poultryman had forgotten that as a gardener he had sought to poison the rats which invaded his

hot-bed; and the diminutive chicks proved that the rat poison was fatal to chicken life, if not to rodents.

On another occasion, after faithful attendance at church services, one beautiful Sunday morning in spring the same amateur poultryman returned home to find about forty fine Brown Leghorn chickens, dead or dying, scattered about the yard. The morning mash for the chicks had unwittingly been mixed with water in which some salt meat had been boiled, and they rendered convincing testimony of the deathly danger to chicken life of too much salt in the food.

The third catastrophe, which also brought its lesson, was the destruction in one night, by an army of invading rats, of some forty pigeons, practically cleaning out the loft.

Experience is a dear if not altogether a lovable teacher, and we all have to learn from her to a greater or less extent. I have no great or appreciative respect for the poultryman who "knows it all," and has closed his course in learning; but my sympathy goes out to the one who is studying and advancing in poultry knowledge, particularly if he be an ambitious and enthusiastic beginner in poultry keeping.

On nearly every farm fowls are kept or found. Too often they are allowed to shift for themselves. Some farmers detest hens. Usually on every farm there is, however, some one who is interested in fowls, or at least desirous of the pocket-money which poultry may supply. I know well a Massachusetts dairy farmer who combines very successful poultry keeping with his dairy business. He is one of many such. Lately a Massachusetts farmer told me with great satisfaction of the copartnership which his two boys, one thirteen and the other nine years old, had formed for conducting the poultry business of the farm. These farmer boys are chips of the old block, and are making a success of the business. Sometimes it is the wife or daughter who takes care of the biddies, usually very successfully. Among the poultry women of my acquaintance I will mention one in New Jersey, who took the special course of instruction, with the pioneer class of 1898, at the Rhode Island College of Agriculture and Mechanic Arts. Although not possessed of the best of health, she has made a success of poultry keeping, and, willing to share her success, has, among other helpful things,

written a nice booklet for women, entitled "Pocket-money in poultry culture," which I can heartily recommend to the wives and daughters on the farms of Massachusetts.

The idea of special poultry farming on a large scale is extending, and large poultry plants are being quite freely established; but the great bulk of poultry products for the market will continue to come from the numberless small flocks scattered through the country. The large poultry ranches all together can supply but a very small proportion of the immense quantities of eggs and dressed poultry demanded by an ever-increasing consumption of these articles of food.

How shall the Beginner begin?

In the first place, do not commence on too large a scale, especially if you have had no experience with fowls. The necessaries are the same in kind that are required in almost any productive business. If we were to discuss the things needful in establishing, maintaining and managing a special poultry farm or a great poultry plant, the factors to be considered might be grouped under the terms land, capital and labor. The same means on a small scale are required for the little poultry plant on the general farm. There must be a place for the fowls, money must be invested in buildings, in good birds and in food and other materials; and, finally, work is unavoidable in the care and management of the business.

Location.

Even poultrymen of experience often make mistakes in choosing a location for poultry keeping, hence it is well for the novice to consider the matter quite fully. If fowls have been previously kept upon the farm, the adaptability of one or more places for the purpose may have been tested. In any case, several things need to be carefully considered. The fowls, to do their best, must live in shelter and comfort. The land should not be wet, and stagnant water in the soil is especially to be avoided. A somewhat elevated slope, with a southerly or south-easterly aspect, if available, is usually preferred. A sandy loam soil in such a location is naturally well drained. If the soil is a strong, heavy clay, naturally too moist, it may be artificially underdrained by

means of tiles, and thus avoid the surplus moisture which seems to favor the development of influenza and roup in poultry.

The atmospheric drainage is something equally important, though not often taken into account. Every one has noticed, in travelling over the roads, up hill and down dale, in the old Bay State, that the cool and often chilly, moist, heavy air settles to the lower places, and tends to remain there. Fowls should live where the air surrounding them is at least fairly dry, even during the wet, stormy weather of the cooler seasons. The inclemencies of the weather, especially the extreme and sudden changes in temperature during the winter and spring, even in the best locations, test severely the strength of constitution of both feathered and unfeathered bipeds here in New England. Violent winds add greatly to the discomfort of fowls, if they are exposed to them. Where the houses and yards are frequently swept by searching winds, the fowls abandon the runs, neglect healthful, outdoor exercise and huddle stupidly in their houses. It is also undesirable to confine the poultry where in the hot weather the air stagnates, and the sun beats down into the unprotected yards or close houses. Both the cold of winter and the heat of summer must be tempered for the comfort of the birds, if they are to thrive and do well for their owner. Shade must therefore not be forgotten in locating the yards or the ranges and the houses. Oftentimes the hen house can be placed where the apple orchard or some group of trees will furnish both shade and shelter. Fowls delight in the conditions found beneath low-growing pines and other evergreens.

Fenced Runs and Free Range.

One thing had best be definitely settled before attempting to keep poultry on the farm. The fowls should not be allowed to run at will within the garden or in and about the farm buildings. Nothing is more aggravating or disgusting than to have the nice vegetables or beautiful flowers scratched up, and the doorsteps, the porch, the paths and the farm machines and vehicles fouled with poultry droppings. Separate the poultry also from the other live stock of the farm.

This is easily accomplished when undertaken in a business-like manner. If the fowls are to be kept near the farm buildings, provide ample yard room, enclosed by wire fencing. The best material for this purpose that I know of at this date is the M. M. S. poultry fencing, which is made of any height ordinarily required, with small meshes below and wider meshes above. It requires ordinarily but few posts, is easily put up and has a very neat appearance when in position. Another way of separating the fowls from the centre of farm operations is to place the houses at a considerable distance from the farmstead, in a pasture, where the fowls will have free range. The latter plan may entail some extra travel by the attendant, and there is the risk in some localities of depredations by foxes, hawks or other wild animals or thieves. The young, strong farmer boy may find advantages in the second or so-called "colony plan," while the housewife will probably find the fence enclosure near the farm house preferable.

The Houses and Yards.

In a fickle and somewhat rugged climate like that of New England, shelter from the extremes of weather, which check the growth of the fowls and their egg production, is necessary. No doubt some of our domestic fowls, if turned loose in the woods, could adapt themselves to the natural conditions, and continue to exist; but the process would certainly reduce their egg production, and probably their size. We attempt to provide, by means of proper shelter, a more equable and comfortable climate, and expect remuneration for this outlay of capital in the form of plump chickens and numerous eggs at a season when prices are satisfactory. Whatever the style or form of poultry building contemplated, it should be so placed that storm water and surface-flowage water will flow away from and not into or under the house. For this reason, a knoll or spot where the ground slopes away from the site is a good place to select for the building. If the soil is liable to be soaked with water at any season, it is well to excavate one or two feet deep, and fill in with stones where the building is to stand. Tile drains may also be laid to conduct the soil water away from

beneath the house. Dryness within the house is further secured by raising the floor six inches to a foot above the level of the ground surrounding the house.

The Kind of House.

There are many forms of hen houses, some of them desirable, others despicable. Each poultry keeper ought to make a study of this matter, as related to the particular conditions of his location and the scope of his plans. Too many hen houses are adapted only for winter conditions. The effect of each season and of all kinds of weather must be kept in mind, if the house is intended to provide a comfortable home for the fowls throughout the year. Winter and summer quarters and a scratching-shed may be combined in one house or in one room, if so desired. Perhaps I can best explain several essential points in home architecture for poultry by describing, as well as I can in words, a house suited, under favorable conditions, for a flock of thirty farm fowls. It is not forbidden to build of stone or brick or concrete; but I should construct the house of wood, and build on runners, so that it could be readily moved if it ever became desirable to change to a new location or to fresh ground. I think that in a house fairly well ventilated at least 30 cubic feet of air space should be allowed per fowl. For our thirty fowls we must then provide 900 cubic feet of interior space. This we can do if we make the foundation of the house in the form of an oblong, 15 by 10 feet, or of a square, 12½ by 12½ feet, and give the roof an average height of 6 feet. The floor may be of boards, concrete, or of dry dirt to be renewed at intervals. Usually the house faces to the south or southeast. The house is highest at the front, and the roof slanting to the rear should have a sufficient pitch to readily shed rain and snow water. I must allow that this form is not very artistic or beautiful. It may, however, be improved in appearance by adding a narrow jet in front, pitching toward the south, and placing a little cupola containing a ventilator at the middle of the peak thus formed. The front should be constructed in the form of two large doors, which are to be opened out in bright, warm weather, allowing the sunshine to reach, during some part of the day, each and every part

of the room. Wire netting may be used to cover the front when opened. Thus the whole house is readily turned into a scratching-shed on pleasant winter days. A door about 3 by 6 feet is placed at the east end, and a window consisting of a single sash at the west end and both near the front of the house. A single sash window is also placed in each of the large doors which form the front of the house. I might add that windows in poultry houses should be protected on the inside by hinged or sliding frames of wire netting, neatly fitted in place, not too close to the glass.

Scantling (2 by 3) will answer for most of the frame work of the house, which is covered on the outside by common boards, and these again, both roof and sides, with sheathing paper and shingles. Our experience in a very windy location indicates that paper as an exterior covering is very liable to prove unsatisfactory; between the boarding and the shingles, however, it acts as a very effective nonconductor of heat, and helps materially in keeping the house comfortable. In extremely cold situations the house may be sheathed inside if necessary.

Furnishing the House.

The interior fittings of the hen house should be as few and as simple as possible, and all easily removable, so that they can occasionally be placed out of doors in the sunshine and fresh air. The roosting platform may be placed 1½ or 2 feet above the floor, in the back part of the house. It should be made of boards, clear of knots, smoothly planed and closely fitted together. Roosts are not always needed, but if thought to be necessary may be made of 2 by 3 scantling, planed smooth, rounded at the upper edges and placed broadside down about 6 inches above the platform. To insure protection of the fowls during the coldest nights from the danger of freezing their combs and becoming chilled, the space above the platform may be enclosed by a curtain, which in moderate weather is kept up out of the way. For nests nothing is simpler or better than small boxes, which may be placed beneath the platform and open towards the rear of the house. A feeding trough is easily made, in the form of a box 2 or 3 feet long and 6 inches wide, with sides 3 or 4

inches high. For holding the drinking water an iron or earthenware dish with flaring sides answers nicely. It may be placed on a little platform raised a few inches above the floor, and may be protected by a hinged frame with slatted sides and a slanting board cover. A box for holding a constant supply of oyster shells and grit may be hung at the side of the room. I hope that this rough sketch of a plan has made plain the desirability of so constructing a poultry house that the whole floor space will be available for use by the hens; that it will catch the first rays of the sun in the morning, and, unless clouds interfere, be blessed by sunshine in some part of the house throughout the day; that the house may be tightly closed and yet well lighted in stormy or cold weather; that it may be opened in front on warm days in winter and thrown widely open on three sides in the hot summer weather.

The Yards.

If the fowls are not to be allowed free range, then double yards should be provided, — that is, two yards for each house or pen of fowls. This plan allows the poultryman to cultivate the soil and grow a crop of green grain in one yard while the other is in use by the fowls. The ground is thus frequently freshened and green food is supplied to the fowls. The yards may, as already mentioned, be neatly and economically enclosed by special poultry fencing, which, for most satisfactory results, should be 6 feet in height. For the kind of fencing described, cedar or chestnut posts, 5 or 6 inches in diameter, should be set at least 2 feet deep in the ground, about 15 feet apart. Gates wide enough to admit a horse and cultivator should be made for the yards. Frames of wood covered with wire netting will answer the purpose, or very neat iron gates may be purchased to match the fences. They should be placed conveniently near the house, and be connected by good strong hinges and latches to stout, erect, firmly set posts.

Can the Hens' Home be made Attractive in Appearance?

Instead of being a blot on the landscape and a disgrace to the farm, the poultry house and yards should be made attractive to the eye. The shingles may be left to nature, to be weather tinted in simple gray, or may with creosote stain be given any color desired to harmonize with the surroundings. The necessity of shade in summer gives opportunity for pleasing effects in the arrangement of trees and vines in the yards and about the houses. Advantage may be gained by the use of fruit-bearing plants for this purpose, as is delightfully evidenced by a little poultry plant that I happen to know of in East Greenwich, R. I. Without large expenditure of capital, a number of neat poultry houses have been grouped among the large, beautiful trees at the rear of the dwelling-house. Fruit trees in the yards and grapevines trained upon the fences furnish an agreeable shade in summer for the fine fowls, and an abundance of luscious fruit in the autumn for the refreshment of the owner and the numerous friends whom he delights to entertain. The effect is very happy in several ways, but I make mention of this aspect especially because of the pleasing harmonious part which this little poultry plant makes in the landscape at "Paradise Farm."

Breeding the Birds.

All the preparations for properly housing the flock having been completed, next comes the momentous question of what breed to select and where to get the best fowls to start with. It is a problem for earnest study, and each poultry keeper must work it out for himself. Consider the market, the local conditions and your own likes and dislikes in the matter. In New England one will not usually go far wrong if he selects one of the so-called American breeds. The Barred and White Plymouth Rocks and the White Wyandottes are great favorites. Of more importance, however, than the breed is the quality of the individual birds selected. Every breed includes poor specimens, which would prove unprofitable under even the best of conditions, and your nice

new poultry houses should shelter only first-class business birds. Here is opportunity for the wise use of considerable capital and brains as well. If you have had some experience in selecting fowls and know a good bird when you see it, all the better for yourself and your poultry business. If you have a lot of mongrels or fowls of mixed blood, work them off as you find opportunity to do so advantageously, and purchase of some reliable breeder of really first-class poultry a pen or at least a trio of the best fowls he will sell you, and pay the price. You may prefer to purchase several sittings of eggs from such a poultryman, and commence your flock of thoroughbreds in this way. This is successfully done in some cases, but there is often the risk to run of disappointment, besides delay in getting well started. When your valuable fowls begin to lay, keep a record of their eggs, using trap nests if necessary; and in hatching note which eggs produce the most and the best chicks. As the chicks grow and develop, note which ones are the most thrifty, which are the earliest to mature, which are plump enough for the table at any age, which develop into early layers, which resemble most their parents and in what respects, and which come nearest the type of the breed. Study all the characteristics, with the idea of learning which birds to select for future breeders. (It is not best here to enter into a discourse upon the principles of breeding, but any one especially interested will find something bearing upon this subject in the twelfth and thirteenth annual reports of the Rhode Island Agricultural Experiment Station.) In the poultry business it is rarely best to have but one string to your bow. In exceptional cases it may be well to depend almost wholly upon the sale of eggs for the income, in others to raise broilers, young roasters or mature fowls for the market; but usually it is well to combine some or all of these, and to also sell eggs for hatching, and dispose of surplus high-class birds for breeders. Combine as many sources of income as are profitable, and push the lines that are most renumerative. It is with this idea in mind that I have strongly advised the purchase of the finest fowls obtainable. The next step is to improve them, which can be done if the poultryman will persist in his study of the individual fowls, watch the results

of his matings, learn to trace cause and effect, and provide better surroundings and conditions than the fowls have previously been accustomed to.

Hatching and raising the Chicks.

If only one hundred or two hundred chicks are to be raised each year, it is certainly a safe and wise plan to depend upon hens to do the hatching and brooding. Pullets which prove to be good sitters and mothers may usually be depended upon to do still better in these respects the next year. If a hen house or room in some farm building is available, an excellent plan is to place a large number of nests in it, and devote the same to the exclusive use of the sitting hens during the hatching season. Orange crates or soap boxes will answer for nests if the poultryman wishes to be very economical. Each nest should be provided with a lattice door in front. I like the idea of placing in the box two or three inches of loam beneath the nesting material, which usually consists of soft hay or cut straw. If convenient, move the broody hens at night to their new nests, and allow them to sit for a day on nest eggs, unless you are sure enough of their good character as sitters to immediately place under them the eggs which they are to incubate. Remove the hens from their nests daily at a regular time, supplying them with fresh water, whole corn or other grain, and provide an abundance of dry, fine soil, so that the fowls can freely and fully dust themselves. Use plenty of Pyrethrum powder or other insect destroyer in the nests and on the fowls, working it thoroughly in among their feathers. Spray the room once a week with a one per cent solution of carbolic acid, and remove or cover with dust the droppings of the fowls. Keep the room well ventilated, — in fact, make the conditions continuously healthy.

If by using hens the chicks are not hatched sufficiently early in the season or in large enough numbers, or if you think that the hens can better employ their time in laying eggs than in hatching them, you are not forbidden to procure an incubator and brooder, or, in fact, several of them, provided the business warrants the expenditure of capital for this purpose. It is easy to learn to run an incubator.

The chief difficulties in chicken culture come before and after incubation. They are found in the successful breeding of fowls to lay eggs that possess strong fertile germs, capable of producing vigorous chicks, and in successfully raising the creatures, after hatching, to marketable size or to maturity.

Artificial Mothers.

A study of the brooder problem at the Rhode Island Agricultural Experiment Station sheds considerable light upon the subject of the artificial raising of chickens. According to Bulletin No. 61 of this station, the causes of the numerous deaths of incubator chicks raised in brooders may be grouped under: —

(*a*) Heredity, or to environment during the period of incubation.

(*b*) Mechanical causes.

(*c*) Imperfect sanitation.

(*d*) Improper feeding.

Under the first heading (*a*) a hint is given that successive alternate periods of heat and cold during incubation are responsible for a large proportion of abnormalities in chicks. Experiments recently undertaken in Germany have strongly emphasized this matter.

Among mechanical causes (*b*) are included crowding and huddling, which, though inexcusable, are far too prevalent, because of the ambitious desire of the poultryman to keep under one hover as many chicks as possible. The remedy is evidently to be found in not crowding. Twenty-five chicks are as many as the novice, at least, should attempt to accommodate under one hover.

Under imperfect sanitation (*c*) is included lack of pure air, sunlight and cleanliness. Tuberculosis, for example, is by these conditions given an excellent opportunity to attack the little creatures. Prevention is in this case the best plan. The hovers should be removable, and, if placed out of doors on bright days in the fresh air where the sunshine can get at them, the germs of this dread disease soon succumb. Careful spraying of the interior with a one per cent solution of carbolic acid helps to keep the conditions sanitary.

Under the head of improper feeding (*d*) very striking

results were obtained by feeding different lots of chickens rations which varied in the extreme. The experiment with the chicks kept in the brooders showed at the end of thirty days, in the lot fed on egg, liver and green stuff, a mortality of 63.7 per cent, chiefly from digestive troubles, resulting in diarrhœa. The lot fed on grain alone showed a loss by death of 32.7 per cent, mainly from digestive troubles, strongly indicated by abnormal enlargement of the gall bladder. The lot fed on grain and green stuff suffered a mortality of 9.5 per cent. The lot fed a complete balanced ration of egg, meat, grain and green stuff had a death list of only 3.5 per cent. By using the proper amount of animal food with the grain food and supplying the necessary green food, a large proportion of the untimely and unnecessary deaths may evidently be prevented; provided, of course, that due attention be given to the other factors of environment, and to the breeding from vigorous, healthy parents.

Another phase of the brooding problem relates to the degree of shelter, the maintenance of a proper temperature and ventilation for the chicks. The sudden variations of the weather during winter and spring in New England make it desirable that there be provided four degrees of protection or comfort for brooder chickens: —

1. An inviting, properly ventilated hover, kept continuously, uniformly and sufficiently warm, to which the chicks may at any time resort, as they would do to the mother hen, and warm up.

2. A ventilated, lighted brooder or apartment, warm enough to protect the chicks from chilling on raw days and sufficiently attractive to tempt them from the hover as much as possible.

3. A run protected from winds and storms by being enclosed within a brooder house, or, if outside, covered with a hot-bed sash.

4. An outside yard, available in pleasant weather, into which even the youngest chicks should be tempted by litter, grain, green food and scraps whenever the sun shines and the winds are not too severe. In some way the chicks must be provided with a sure refuge, where they will be comfortable

whatever the weather. They should, however, by every means possible be induced to keep out in the fresh air and take exercise as they would with the mother hen in the pleasant spring weather. These hints will also apply to a considerable extent to chicks raised by the natural method.

One of the secrets of successful chicken raising is to keep them constantly growing. To do this, no condition can be tolerated which gives the animal a check in its development. As soon as the young pullets can be distinguished from the cockerels, the birds of different sexes should be separated, and the pullets at any rate should be given free and abundant pasture range. They will thus obtain a sure supply of green food, and will usually find considerable animal food in the form of grasshoppers, worms and various insects, which will help to balance the grain food commonly supplied them. The poultryman is fortunate if he is able to pasture the growing birds where they can easily find running water to drink.

Selling the Products.

Sell direct to the consumer, if possible. Dispose of the poultry products at the time when the condition of the same and the state of the market yield the greatest net profit. In some localities a chicken will bring more as a broiler (at one or two pounds) or as a young roaster (three to four pounds) than at maturity, and the food and care necessary for the added growth and weight may be saved. In culling out the chicks to be killed and sold as dressed poultry, do not sacrifice the promising young thoroughbreds. Save them for breeders, to replenish your stock, and, in case of a surplus, especially of cockerels, to sell to other poultrymen. In disposing of eggs, some poultry keepers find it profitable to sell to special customers, who are ready to pay more than the market price for them. Ordinarily, however, the eggs will go into the regular market. Even in this case it pays to be careful that the product is fresh laid, clean and uniform in size and color. This problem of the successful disposal of poultry products after the labor and care of their production is one which varies greatly, according to the conditions in each case. It must be studied out on the spot. Fortunate

will it be for the profits if the poultry keeper is a shrewd salesman. One thing at least should be insisted upon: the farmer's wife or son or daughter who undertakes to care for the poultry should receive the income which comes from all products sold, and full value for all eggs and chickens furnished for the table. The laborer in the poultry yard is worthy of his hire.

The Poultry Keeper should be an Account Keeper.

One thing further I desire to emphasize most earnestly; that is, the keeping of records and accounts. Here is where most farmers and poultrymen lack. They do not know actually how their business stands financially, and are really often working at a great disadvantage, because they do not actually realize which part of their farm operations are bringing profit and which are entailing loss. In the case of the poultry keeper, the matter is not one of difficulty and need not require much time. A record should at least be kept of the eggs laid daily by each flock or pen of fowls; and after the doing of this has become a habit, it will not require much urging to induce the interested poultryman to keep individual records of the egg production of his best breeders.

The financial record is also a simple affair. An inventory is made at least once a year of all the capital invested in the land, the buildings, fences, furnishings, tools, fowls, and of the estimated value of the poultry products on hand. The sum total of all these values is, in commencing the account, charged against the business; that is, placed on the debit side of the account. Then, during the year (or shorter period of time, if desired), everything that is purchased, including food, tools, lumber, nails or supplies of any kind, new fowls, etc., and every hour of labor at a fair price, is charged against the business. On the other hand, the value of every egg and every fowl sold or used for the house table and of everything that is disposed of, including the poultry manure and the feathers if they can be sold, is placed on the credit side of the account. At the end of the year, or, in fact, whenever the poultryman wishes to balance his ac-

counts, a new inventory is made of all the belongings of the poultry plant, including new purchases, fowls, tools, etc., and the estimated value of all the poultry and poultry products and food on hand. The sum of these is placed on the credit side of the account. The difference between the total amounts of the debit and credit sides of the books should show the actual profit or loss. We will hope that it is a good round sum on the right side of the account.

REPORT

OF THE

STATE BOARD OF AGRICULTURE

ON THE WORK OF

EXTERMINATION OF THE GYPSY MOTH.

Commonwealth of Massachusetts.

To the Massachusetts State Board of Agriculture.

Your committee in charge of the work of exterminating the gypsy moth presents herewith a report of work performed during the year 1900.

In common with other State departments, your committee is authorized to continue its operations during the month of January, "until the pleasure of the General Court is made known, at the rate of expenditure authorized by the appropriations for the preceding year." Under this law your committee continued its field work as described below, throughout the month, at the end of which time all the employees were discharged, with the exception of a few officers whose services were required in completing the accounts, collecting tools and other work incident to closing up field operations.

During the month, as weather permitted, scouting was prosecuted, as rapidly as was consistent with thoroughness, in Boston, — particularly in the outlying wards of Roxbury and Dorchester, — in Saugus, Swampscott and Reading. One feature of this work was the finding in Dorchester of a few scattered egg-clusters near the Neponset bridge and a small, compact colony at Cottage Street. Another feature of a more gratifying character was the result of a thorough inspection of Franklin Park by expert employees. It will be recalled that some years previous a serious colony of the moth existed in this park. This inspection confirmed the results of recent examinations, no trace of the moth being found.

At other times, during and following storms, attention was given to clearing up infested woodland in Swampscott,

Melrose, Winchester, Newton and Belmont. The woodland thus treated had been found slightly infested during the previous year, and the destruction of underbrush and dead trees was a necessary measure to provide for the capture by burlaps of the straggling survivors later in the season. Experience has shown the profitableness of this practice, and the woodlands so treated were put in excellent condition for burlapping the following summer. Had we been able to attend to the burlapping as in past years a large number of colonies would have been exterminated.

Mr. F. C. Moulton has been employed for the entire year, and has had charge of the material, tools, etc., stored at No. 17 Russell Street, Malden. He has taken an inventory of the stock and noted the condition during the season in all sections of the infested territory. The secretary of the Board has also visited the different localities, to examine colonies or confirm reports, as often as his other duties would permit. This committee has also visited the territory several times, and the results of these investigations are summarized below, the statements under this head being mainly a condensation of Mr. Moulton's report.

Condition of the Infested Territory.

In general, the gypsy moth has made gains during the year. In towns and places ready for extermination in 1899 the moth has made a great gain, so much so that in places they begin to attract attention. Belmont has sent in a number of complaints, and there have been several from Malden and some from Medford and Everett. The moth has been found in considerable numbers in all those colonies not cleaned out last fall. Among these are the Young colony in Burlington, the Cottage Street colony in Boston, the Spring Street colony in Belmont and the Brooks estate at West Medford.

Malden.

Malden is generally infested, and nests on street trees in the residential parts of the city are quite common. On Middlesex Street, on Converse Street and in the northern part of the city there are many nests. Complaints have also

been received from Eastern Avenue. Highland Terrace, in the woods north of Forest Dale Cemetery, is infested. As many as sixty caterpillars under one burlap were found here (these burlaps are those put on by the employees of the gypsy moth committee in 1899), and several hundred destroyed in a very short time. In Section 5 larvæ were quite plentiful this summer, from one to twenty-five under each burlap in the central part of the colony. In woodland off Lebanon Street from one to six were found under nearly every burlap.

Everett.

Everett is generally infested in nearly every part. The moth has made a great gain in some parts of the city. A very large tree stands on Main Street, which is infested with nests of the moth. One from the ground can count fifty nests on this tree. The branches of this tree reach completely across the street.

Medford.

Medford is becoming generally infested. There is a tree containing fifteen or more nests close beside the entrance to the Medford livery stable. Nests can be found in nearly any part of Medford woodland. General Lawrence has done good work in destroying the moth on his property; Mr. Albert F. Sise has also done good work in this direction. Colony 9 is infested. The estate of Walter Wright is badly infested. Five hundred larvæ were counted under and around one burlap on this estate, and not over two-thirds of the larvæ in the mass were counted, there being at least seven hundred under and around that one burlap. Mr. Wright's man reported that he killed twenty-eight thousand larvæ in a space of thirty feet square. The Metropolitan Park Commission had several men at work all summer on and around Pine Hill. At West Medford the Brooks estate is badly infested. Sixty feet of a large and beautiful evergreen hedge on this estate were completely defoliated and killed this season.

Melrose.

In Melrose the moth has made a great gain. Wyoming Cemetery and vicinity are generally infested. Park Street is

infested on the north side. On Mountain Avenue larvæ were found on nearly every tree.

Winchester, Arlington and North Lexington.

No bad places have been found. The colony at North Lexington was exterminated several years ago, and nothing was found there this year.

Belmont.

There are several infested places in Belmont. A good many larvæ were found at the head of Prospect Street. A row of quince bushes off Alexander Street contained about one hundred nests. Four willow stumps on Spring Street have probably one thousand nests on and around them.

Burlington.

The Young colony off Spring Street is a very bad place. The bank wall, rubbish and empty cans there are full of nests, probably thousands. This colony is in the yard of a market gardener, and the caterpillars are likely to be distributed over his route. The Cummings colony was well cleaned out, and there are but few nests at present. There are fifty-one trees here that are dead as a result of two years' stripping.

Newton.

The efficient street commissioner, Mr. Ross, did good work in destroying the larvæ last spring, so far as he was able with the resources at his command; nevertheless, Newton Highlands is quite generally infested.

Saugus.

No bad places have been found, but the nests are widely distributed.

Lynn.

No badly infested places were found. A hasty inspection of the residential portion of the city revealed no nests.

Georgetown.

A hasty inspection revealed only one nest, found near the centre of the area burned over.

The foregoing is a summary of the condition of the infested territory, so far as we could determine it with the limited appropriation at hand.

The fuller notes are at the disposal of any interested. These notes are valuable, as confirming the thorough and exact information in regard to the condition of the territory given the Legislature of last year.

In the report made to the Legislature in January, 1900, your committee summarized the condition of the infested region in the following words: —

From the results of the past two years, it is evident that the work against the gypsy moth in Massachusetts is already approaching its final stages. The large colonies have been practically wiped out; many of the smaller colonies have been exterminated or are thoroughly under control, and need but two or three seasons' work to secure their absolute extermination. Three years ago there were many localities in the infested district where there were large masses of egg-clusters; to-day the infestation of the region consists of the scattered remains of former colonies and their offshoots, which must be subjected to continual examination and treatment for a series of years. Since there are no longer large colonies to demand attention, a greater amount of labor will be available for the work of inspection and the treatment of the smaller colonies.

These statements were made only after careful examination of danger points and thorough inspection in the vicinity of former colonies. Your committee believed these statements to be a fair and honest summary of the conditions then existing. The results of the past season give ample proof that such conditions did exist. With no effort to check the increase of the moth, there has been no serious damage by the pest, except in small areas that could have been readily controlled, had there been any funds available. This verifies in the best possible manner the summary just quoted, and shows that, at the time the work of the committee was checked by the Legislature, the moth was well under control, and its total extermination already in sight.

These indisputable results were accomplished in the face of the most discouraging difficulties. The Legislature of

1891 directed the Board to provide and execute measures for the extermination of the gypsy moth. This action was in response to a public demand. That Legislature and those following believed in extermination; so did this committee and the Board of Agriculture; and the result, as declared by the investigating committee of the Legislature of 1900, that "There are to-day, so far as known, no large colonies," proved the wisdom of the Legislatures and the Board. While there were those who, all these years intervening between 1891 and 1900, questioned the policy of extermination, and while the committee was handicapped and the work hindered by delayed action and inadequate appropriations, nevertheless the Board, the committee and the Legislature never gave up the idea of extermination from the first day until the close of the work this year. This view was in accord with the counsels of all economic entomologists of note throughout the country who had investigated the work. With this view the work was carried forward with success each year and the end was near at hand.

The Board of Agriculture did not seek this work; it was thrust upon it by the State. Its members have received no compensation for services which have been freely given. The work of the Board in procuring the enactment of the law against worthless fertilizers was for the benefit of the farmer largely; in its grand record in stamping out pleuro-pneumonia, cattle owners and beef producers were most deeply interested, and its perfect success has saved millions of dollars to the country; but in this case the work is not primarily for the farmer only. This insect is located largely in the metropolitan district; it feeds on every green thing; the evergreens are killed by a single defoliation; the deciduous trees will withstand two defoliations, unless leafless for too long a time, as in the Burlington colony.

The investigating committee of the Legislature of 1900 made its report. We will not criticise it, but, that its findings may have due weight and just consideration, we place on record, for the perusal of those who may in the future examine into this subject, as a part of this report, the testimony of one who was a member of the second Gypsy Moth

Commission and secretary of this committee during all the work, as given before the committees on ways and means and agriculture of the House of Representatives, then sitting jointly to consider the report of this investigating committee. It will give the reader a hint of the conditions under which the investigating committee's report was sent in.

Testimony before Committees on Ways and Means and Agriculture, sitting jointly, April 5, 1900.

I have been much interested in this report of the investigating committee, and have examined it somewhat critically, and find that we have been condemned for our success in the enterprise. I find on the fourth page of the report that the investigating committee say: "It has not been clearly demonstrated to the committee that the actual damage done thus far has been of any considerable damage financially." Why is this? Simply because the gypsy moth committee, in whose charge the work has been, has succeeded in its work, — for which we are condemned. Again, they say: "There are to-day, so far as known, no large colonies." Why? Simply because we have succeeded in our work, — for which we are condemned. Again, they say: "We find no substantial evidence that gardens, crops or woodlands have suffered serious or lasting injury." The reason for this is the same as given before.

Again, the committee criticise the Board of Agriculture, on page 5, and say that, "the Board has fairly left itself open to adverse criticism in this particular," *i.e.*, the dissemination of information as to the danger from the depredations of the moth; and say: "Such methods should not be tolerated." What is the Board of Agriculture for? What was the duty put upon the Board of Agriculture by the Legislature in reference to the moth? Has it not been a part of its duty to inform the State as to the necessity for appropriations? How otherwise should the Legislature be able to judge whether the appropriation was necessary, and how much, and who was to give the information, if not those appointed by the State to do the work and care for it?

The investigating committee say, also, on the same page: "Continued experiment and study have given us the most approved methods of defence and attack, and to cope with and check its spread is now a matter of comparative ease." To whom is the credit of this due, if not to the gypsy moth committee? Who has

experimented and sought for expert advice of all men in the country who were able to give such expert advice, and taken advantage of it to bring matters to their present condition, if not this committee? And this committee is condemned for its success. Again, the investigating committee say, on page 6: "There are to-day no known colonies in existence and no immediate danger of serious outbreaks." Yet the committee in charge is condemned, and the investigators say suppression is all that is necessary.

On the same page the investigating committee criticise those in charge of the work for the number of officials employed, as director, assistant director, superintendents, agents, inspectors, etc. As a member of the committee from the first year, I wish to say that the appointment of these officials was made necessary by the exigencies of the case. Being obliged every year, from the lateness of the appropriations, to employ a large number of new men, having lost many of our best men, it was absolutely necessary to have a sufficient number of skilled and experienced men to instruct the new men. Each appointment, each increase of an official was made deliberately after investigation by the committee. These officials were in part made necessary by the immense amount of territory that had to be attended to. Work in thirty towns is quite different from work in a single shop, even though there may be several rooms in that shop; and to enable those in charge to know and to keep in close touch with all that was going on, not one of those officers could be spared.

Again, the report of the investigating committee says, on page 6: "When it becomes necessary to suspend field work, owing to the exhaustion of funds, officials are retained, doing privates' work, at no reduction of salary." That is true, and it is true because the committee believed that to be the most economical plan for the State. These officials, superintendents, inspectors, etc., are the skilled men of the force, — men of the most experience, of the greatest reliability; men the most capable, not only of directing the force, but of performing the work; and they were retained for two reasons: first, because it was probable that the work would be again undertaken, and, if so, because of the loss of many expert men, it was absolutely necessary to have a sufficient number of men capable of instructing the new hands; and, second, those men were retained because, if they were not given employment, being bright men, capable, and the kind of men everybody desires in their own work, they would get other employment, and we

would be handicapped with no one to train the new force. Again, each one of these men is capable in field work of earning his advanced pay, be it three or four dollars a day, because of his superior capability, reliability and experience. Especially is this true in the case of *expert field work*, which was largely the work in which these men were employed when the privates were not employed.

Again, the committee say, on page 8: "The system of scouting, necessary under the policy of extermination, is an expensive feature of the work; in its practical operation, barren of positive and justifiable results; and, as ordinarily carried on, a manifest waste of money. Dozens of men racing through the woods a hundred yards apart, with the avowed object of locating nests and noting evidence of the existence of insects, present a ludicrous and contemptible exhibition of inefficient management somewhere." The fact is that no such scouting is done. The nearest approach to it is when men have been sent to examine woodland to locate colonies where work may be started in the clearing of such woodland. How is the committee or anybody in charge of this business to find colonies without such examinations?

The investigating committee say, on page 10: "Much of it [evidence] comes from unreliable and prejudicial sources, which hardly entitle it to a passing consideration." Yet they have largely printed it here for the information or misinformation of the Legislature and the people. The fact is, Mr. Chairman, that a considerable part of the evidence of the wasteful and extravagant expenditure of money, the lack of control of the men and bad management and loafing came from two witnesses, ex-employees, whom you, Mr. Chairman, heard here last year; and I want to say to you, having heard their evidence at both hearings, that it has enlarged several times over what they were able to give you then. From the nature of the case they can have had no further experience, and the enlargement of the evidence must be for a purpose. Mr. Chairman, doubtless you can obtain the evidence of these two men from the stenographer's report for the investigating committee, and, if you will take the trouble to look it over and compare it with what was said last year, you will understand to what I refer. Mr. Chairman, you remember how little weight the evidence of these two men had with your committee last year. With the investigating committee, the case seems to have been reversed.

On page 12 the committee say: "Patronage should not be held out as a reward for legislative action." Patronage has never been

held out by anybody with authority to offer it. If it has been done, it has been by those without authority, or by men having no connection with the service.

In reference to the statement on page 17 of the estimate made by "the Board, through its chairman," in 1894, I want to say that the committee are entirely unfair in their treatment of these estimates, for, by their own statement in this report, on page 11, it will appear that the conditions of the estimate have not been at all complied with by the Legislature; yet this investigating committee propose to hold the gypsy moth committee or the Board responsible for that estimate, when their side of the proposition has not been fulfilled.

On page 20 the investigating committee say: "The committee herewith submit the stenographic report of that portion of the testimony of one witness containing his views of the published reports of the Board;" and say: "The quotations from these reports we make a part of this report; the comments and criticisms of the witness are his own, and he alone is responsible for them. We make our own deductions."

It is to be noted that the committee accepted these quotations from the reports without investigation as to their accuracy, and say: "We make the quotations from these reports a part of this report."

In the first paragraph the witness quotes from an alleged report of 1890: "We have thoroughly investigated the outskirts, and found but one case where it was beyond the limits of our first investigation." Now, Mr. Chairman, I want to say to you that there was no report in 1890. This matter was not put into the hands of the Board of Agriculture until 1891. The quotation could not have been in a report, for there was no report extant. Possibly he may have found a newspaper statement of what the first commission may have said, but the gypsy moth committee had nothing whatever to do with it.

On page 21 this witness quotes from the report of 1891: "In the fall it was found only one-tenth as many as in the spring." What the report said was: "It was found that in the section where they were most plentiful in the spring there were comparatively few, not more than one-tenth the number there were last spring." An entirely different statement. Then, again, he quotes: "If eggs can be gathered, few will appear in the spring, and can be easily destroyed." But the committee said: "The committee believes the work of gathering the eggs throughout the

entire district infested should be completed in the most thorough manner before the appearance of the eggs in the spring. If this can be accomplished, we believe that the numbers of the caterpillars that will appear in the spring will be comparatively small, and that they will be so much scattered that they can be found and destroyed without the spraying of the trees and shrubs of the whole country."

Again, the witness quotes: "Work throughout the season was so effective that all the large colonies have been destroyed." While this language is correct, it is entirely misleading, for the report says, afterwards: "There is still a large area in which the eggs have not been destroyed."

The quotations in reference to 1892 are not correct, but in themselves are not particularly misrepresenting, but other modifying statements are ignored, thus in effect misrepresenting the committee. The report for that year says: "There are large areas of woodland in the infested towns. There are points in these forested districts known to be infested. There are probably other points where colonies have been established. There are about four hundred acres of woodland which will, if it is allowed to remain, continue to be an uncertain element in our problem."

The witness says, quoting from our report for 1893: "The condition of the infested territory is better than last year." What the committee said is: "The condition of the *worst infested territory* is believed to be better than it was one year ago." He quotes: "The moth is now so rare in most of the towns that only by close inspection can it be found." What the committee said is: "As a result of the work already done, the moths are now very rare except in limited localities in the central towns of the infested district. But they are scattered here and there over a large part of this whole area, in small colonies such as started from the original importation by Mr. Trouvelot in Medford." In the same report the committee said: "In this territory are about twelve thousand acres of woodland which may be more or less infested. Small areas here and there in the woodland are known to be infested, while others may be." The committee also said: "The committee had asked for an appropriation of $165,000 the year before, so that this work might be done, but it received only $100,000. Again, in January, 1894, it asked for the same amount, but it was not given."

I will not take your time to go over all these quotations in order, but simply desire to call your attention to one other, under 1896,

where he quotes from the report: "With a little more money we can exterminate them all." No such statement or sentence can be found in any report of the Board; the quotation is manufactured out of whole cloth. The committee that same year asked for $200,000.

I now want to call your attention to the closing remarks of this witness, on page 23, where he intends to be understood that the committee has covered up or misrepresented the size of the infested territory by failing to mention the towns that have been infested. The facts are these: —

Towns reported in 1891: Medford, Malden, Everett, Somerville, Arlington, Winchester, Stoneham, Melrose, Saugus, Revere, Chelsea, Cambridge, Belmont, Lexington, Woburn, Wakefield, Lynn, Swampscott, Charlestown, Lynnfield, Salem, Peabody, Marblehead, Beverly, Reading, Brighton, Watertown, Waltham, East Boston, Winthrop, — thirty towns. Danvers was reported in 1893, Burlington in 1893, Boston in 1894, Nahant in 1895, Brookline in 1895, Lincoln in 1897, Manchester in 1898, Georgetown and Newton in 1899.

Now, Mr. Chairman, I submit that a partial quotation may be as misleading as a false quotation, and here we have partial quotations which misrepresent the position of the Board, and false quotations which have no foundation whatever.

Your committee has no new recommendations to suggest, but refer you to our report of last year. If we should suggest them, they would look beyond the present to the future welfare of the State; they would appeal to the statesman who sees not the present alone, but the present and future as one. We made an appeal to the investigating committee of the Legislature of 1900. The appeal was ignored by the committee; the Legislature did not hear it. That the gypsy moth committee's position may go on record, we quote the language of the appeal: —

And now, gentlemen of the committee, this matter is in your hands. We have fought a good fight. We have done the best we could with the means at our command. We know the pest should have been exterminated ere this. We have done all that we could to induce the Legislatures to realize the economy of vigorous work with sufficient appropriations to secure it; but they

have thought themselves the wiser, and, because of their policy, extermination has had to partially give way to temporary expedients for holding in check. That was not our fault, and we are not at all responsible for it. No men could have done better work, no methods could have produced so good a result. We are proud of the record, and, under these conditions, more than satisfied with the measure of success. This old Board took the burden unwillingly, and has labored diligently and with self-sacrifice for the good of agriculture, and therefore of the Commonwealth. If others can do this work better, give it into their hands at once, and I pledge the support of this Board to aid their every effort to the extent of our ability. *We only plead for the extermination of this fearful pest*, for the carrying out of this work to the end. Suppression is *gradual expansion*, — nothing less and nothing more. It may delay for a few years, but its result is as certain as that night follows day. As I have said, this is the broadest, the most far-reaching, the most momentous question before any State Legislature in this country. It is not a question of politics and finance, it is a question of statesmanship and the future welfare of our country. We shall not live to see the blight of this insect stretching through our forest areas from east to west; but it will come if you decide to abandon the policy of extermination, and nothing can stay its destructive course, once escaped from its present limitations. You do not realize the danger from what you have seen, for our work has been so well done that you must turn back to Medford in 1890 or to the small colony in Georgetown to appreciate its destructive power. The farmers cannot and will not stay or control this pest. There is only one of two things, — exterminate, or let alone. We have proved to you by intelligent testimony that extermination is possible and assured, if the Legislature will not hamper the work. We have shown you that our methods are the only practical methods, and that they will accomplish the result. We have brought the most intelligent witnesses, from Berkshire to the Cape, to bring to your notice the strong sentiment of the State, — not farmers alone, but men in other callings with views broad enough to grasp this great question. We realize the importance that will attach to your verdict. We have established every point. We have confounded every statement of political intrigue. We await your verdict without anxiety. We have done our duty without fear and without reproach, and if you call upon us to lay it down, we shall relinquish it with pleasure; only, as

our last word, we pray you, for the good of the State in the future, for the good of coming generations, let the work go on, and history will applaud the broadness of your foresight, the wisdom of your verdict.

These were the final points in the committee's work before the Legislature of 1900. That report and this report will be history. The future will record the verdict.

Only one other point, — there has been expended more than a million dollars in the extermination of this pest. It was necessarily begun in the nature of experimental work, and wrought out until the system is acknowledged superior to any known. The national government solicited the privilege of exhibiting models of the spraying apparatus at the recent Paris Exposition, where they received the gold medal for excellence. This award attests their value. True, a million dollars seems a great sum to those who know nothing of the magnitude of the work performed in these nine years; and yet, if it had accomplished nothing in the extermination of the gypsy moth, the result in more effective and cheaper insecticides, as, for instance, arsenate of lead, and the improved machinery and appliances discovered and invented under the administration of this committee, and now in use all over the State for the destruction of the elm-leaf beetle and other tree pests, with no patents to increase their cost, are and will be of more economic value to the State than all the money expended.

The Board of Agriculture has done its work. The State of Massachusetts, who, through its Legislature, stopped the work when "not a large colony" could be found and when extermination was in sight, has taken upon itself the responsibility, and there let it rest. This Board has no apologies to make; it has given its best efforts and done its best work every day and every hour from the beginning to the end. It has given this work into the hands of a carefully selected committee. Their reward and its reward are the benefit to the people. One day in each fourteen has been set apart by this committee for careful investigation and consideration of means, methods and results. It looked forward confidently to the laurels that would crown its successful issue, — the

greatest work of this kind ever laid upon a board, or accomplished by a Commonwealth for the future good of a nation.

The law of 1891 has not been repealed. This committee of the Board of Agriculture has not been discharged. The property of the State is in its care and keeping, with a special appropriation to meet the expenses that must accrue, until such time as the Legislature of 1901 shall make known its will. Under our control an inventory has been taken, and is on file at this office. Personal property that would accumulate expense has been sold and the money turned into the State treasury. Due care has been taken of all other, that it shall not deteriorate or waste. As in duty bound, we herewith submit our report.

AUGUSTUS PRATT.
FRED W. SARGENT.
JOHN M. DANFORTH.
JOHN G. AVERY.
WM. R. SESSIONS.
JAMES W. STOCKWELL.

Financial Statement for 1900, Gypsy Moth Committee.

Appropriation to May, 1900,		$18,000 00
Augustus Pratt, expenses,	$74 16	
F. W. Sargent, expenses,	47 89	
J. M. Danforth, expenses,	26 42	
J. G. Avery, expenses,	111 50	
Wm. R. Sessions, expenses,	30 40	
J. W. Stockwell, expenses,	–	
C. H. Fernald, expenses and remuneration,	488 44	
E. H. Forbush, director, salary,	733 33	
Travelling expenses of director and men,	91 94	
Teaming, livery and board of horses,	357 89	
Wages of employees,	14,234 19	
Rent of office, storehouse and land,	166 67	
Supplies, tools, insecticides, printing, etc.,	1,423 75	
	$17,786 58	
Balance on hand Jan. 1, 1901,	213 42	
		$18,000 00

Appropriation from May 1, 1900, to Jan. 1, 1901,		$1,000 00
Teaming, livery and board of horses,	$133 01	
Wages of employees,	350 11	
Rent of office, storehouse and land,	328 53	
Supplies, tools, printing, etc.,	121 19	
	$932 84	
Balance on hand Jan. 1, 1901,	67 16	
		$1,000 00

TENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED

UNDER CHAPTER 412, ACTS OF 1891.

JANUARY 15, 1901.

DAIRY BUREAU—1900–1901.

J. L. ELLSWORTH, WORCESTER, *Chairman.*

C. D. RICHARDSON, WEST BROOKFIELD.

F. W. SARGENT, AMESBURY.

Executive Officer.

J. W. STOCKWELL, *Secretary of the State Board of Agriculture.*

General Agent.

GEO. M. WHITAKER, BOSTON.

REPORT.

The work of the Dairy Bureau for the past year shows greater results than for any previous year of its history. The year 1900 has been a record breaker in number of cases in court, number of convictions and amount of fines imposed. In our report for 1899 we told of a year of exceptional activity, but we did even more in 1900 than in the previous year. From one point of view we regard this record with much satisfaction. As long as there are those in the community who are law breakers, — who deal in counterfeit, adulterated or low-grade products, — we feel some pride at the number we have been able to bring to justice, and at the amount of success which has attended our fight for pure, honest, standard dairy products. We also believe that, if the amount accomplished is measured by the appropriation for this department, we have further reasons for self-complaisance; for, creditable as are the results secured, they have been limited by the appropriation; we have been compelled in a number of instances to go slowly or to suspend work altogether, because the money at our disposal was running low. The city of Boston pays $13,000 for expenses and salary of its milk inspector, while the State of Massachusetts appropriates only $8,200 for its Dairy Bureau, with which to cover the whole State. The real disproportion of the appropriation is even more than this, for the Boston milk inspector can reach any portion of his territory for an eight-cent fare, while to send an officer of the Dairy Bureau to North Adams, for instance, may mean $7.50 in railroad fares and at least one night's hotel bills.

Viewed in a broad way, our record of the past year does not bring unalloyed satisfaction. The true citizen ought not to regard with pride a long list of criminal prosecutions or large figures in the annual summary of court records. While such facts may speak well for the vigilance of the authorities

and the faithfulness with which they have worked, the statement also tells of the existence of a considerable spirit of lawlessness, of the existence of a class that has no respect for the expressed wishes of the majority of the people, — a class that would strike a blow at the very essence of democratic institutions.

We feel that this is emphatically true in regard to the violation of food laws. The violators of these enactments do not come from the so-called criminal classes, from those with inherited appetites and passions, from those whose ignorance has blunted moral instincts. The people who, from a spirit of avarice, impose upon the consumers of the State adulterated, fraudulent or low-grade foods, are often gentlemen of fair or even good standing in business, society or politics. These gentlemen cheat consumers, injure honest commerce and defraud producers; and in so doing they show a most reprehensible disrespect of law and order, and by their standing they exert a peculiarly bad influence in the community.

The membership of the Bureau has undergone a change during the past year by the death of the chairman, Mr. D. A. Horton of Northampton, Mr. F. W. Sargent of Amesbury being appointed in his place. This change removed from the Bureau the last of the original appointees. The Bureau was organized in 1891, with Messrs. C. A. Hartshorn of Worcester, D. A. Horton of Northampton and Geo. L. Clemence of Southbridge as members. As terms of office as members of the Board of Agriculture expired, Mr. Hartshorn was succeeded by Mr. Ellsworth and Mr. Clemence was succeeded by Mr. Richardson. On the reorganization of the Bureau, after the death of Mr. Horton and the appointment of Mr. Sargent, Mr. J. L. Ellsworth, the senior member, was elected chairman. The administrative work has continued in the same hands as heretofore, but with a change in the title of the position and with a statutory definition of the duties involved.

In the reports of the Bureau for the years 1896 and 1897, attention was called to the vague and somewhat misleading allusion to the position in the statutes; chapter 412, section 6, of the Acts of 1891, providing for an "assistant to the

secretary of the board of agriculture, . . . to assist in the work prescribed in the eleventh section of this act." Last winter's Legislature remedied this, and, in the interests of increased efficiency, gave the Bureau's administrative representative official recognition as an independent individuality, and defined his duties.

Chapter 368, Acts of 1900, says: "The state board of agriculture shall at its annual meeting elect a general agent of the dairy bureau, to assist the bureau and to oversee, under its direction, the work prescribed in section eleven of chapter four hundred and twelve of the acts of the year eighteen hundred and ninety-one."

Two regular inspectors have been employed during the year, P. M. Harwood and Ralph M. Horton. Several special inspectors have been employed from time to time for brief periods to help in detective work, where a person whose appearance was unfamiliar could temporarily be of great service. Three chemists have been employed: Dr. B. F. Davenport for the eastern part of the State, E. R. Barker for Worcester and E. B. Holland of the Hatch Experiment Station for the western part of the State.

In a general way and statistically the work of the past year may be summarized as follows: —

Inspection of places in which dairy products or imitation dairy products were sold or stored, but where the law seemed to be complied with and no samples were taken,	1,612
Real or imitation butter, samples taken,	755
Milk, samples taken,	68
Cream, samples taken,	3
Cases in court,	178
Meetings addressed,	18
Work at fairs.	

The comparison of the court cases for 1900 and some previous years may be of interest: —

1900,	178	1897,	27
1899,	87	1896,	79
1898,	60	1895,	82

Imitation Butter.

The work of the past year has been almost exclusively devoted to the enforcement of the imitation butter laws, the manufacturers of this counterfeit product having crowded its sales harder than ever. Last year we reported renewed exertions on their part, avarice having lead them to become law breakers. The tendency during the year just past has been even stronger in the same direction. These increased efforts on their part at violating the law have compelled us to confine our labors to checkmating them, with the result that the offences charged in the court cases have been as follows: —

Violation of the anti-color oleomargarine law,	145
Serving oleomargarine in hotels and restaurants without giving notice,	32
Obstructing officers in the prosecution of the work,	1
Total,	178

Evidence has also been secured of several violations of the law which could not be tried during the year, and will appear in the next year's records, and of several additional cases in which the defendant could not be found. Of the cases for violating the anti-color law, the complaint in nearly every instance charged "possession with intent to sell within this Commonwealth," although we had evidence of actual sales in 55 cases. In 49 out of these 55 cases butter was called for by the purchasers; in 2 of the remaining 6 the seller supposed that his customer was a pedler, and suggested that the article be sold as real butter. In 17 sales taken at random the average price paid by the supposed consumer was 22.23 cents per pound. If the manufacturer charged the dealer 13 cents, the retailer made a profit of 70 per cent.

The oleomargarine cases which we have had in court for the past few years have been as follows: —

	Anti-color Law.	Hotel and Restaurant Law.	Obstructing an Officer.
1900,	145	32	1
1899,	47	13	5
1898,	13	3	5
1897,	16	5	5

The result of the court cases in 1900 was as follows: —

Convictions,	144
Acquittals,	26
Nol pros,	8
Total,	178

Some of the cases that were lost or nol prossed resulted in smoking out the party who was really guilty and in securing his conviction, so that the above 34 cases are not wholly a debit. Of the 26 cases lost, a few are of more than ordinary interest. In the case of obstructing an officer, the offence consisted in the refusal of the defendant to unlock a room in his residence in which imitation butter was stored. The court ruled that a mere refusal to unlock a room was not an obstruction, hindrance or interference, but informed us that we could have broken into the room, under the law. In 3 cases the defence showed that the parties being tried had bakeries, hence finding imitation butter in their stores did not make out a *prima facie* case of *intent to sell.* In 2 instances the colored oleomargarine was found in the possession of pedlers in a city adjoining the Rhode Island line, and the court held that it had a reasonable doubt as to whether the imitation butter was in defendant's possession with intent to sell *within this Commonwealth.*

In four cases the defence claimed that the sales took place, as a matter of law, in Rhode Island, and the court held that the facts presented were not inconsistent with that theory. The defendant was at once complained of for "taking orders for the future delivery of an imitation of yellow butter," and was convicted. This, we think, is the

first case ever tried under that particular clause of the anti-color law. In one instance the defendant sought to clear himself by the claim that he had disposed of the business before the sample was taken, and the alleged purchaser was one of his witnesses to confirm his evidence; a complaint against this purchaser was sworn out while the trial was in progress. When the defendant was acquitted, the new purchaser was arrested, arraigned, fined and paid $100 before leaving the court room.

In addition to the above imitation butter cases there have been two perjury cases. In one the judge of the district court believed perjury had been committed, and bound the defendant over for the grand jury. When the oleo dealer found that he had been indicted for both perjury and the sale of imitation butter, he offered to plead guilty to the oleomargarine case and pay what fine might be imposed, if the perjury case would be filed; to this proposition the district attorney agreed. In the other case the defendant set up an *alibi*, which did not convince the judge of the district court, and conviction followed. The same tactics in the superior court led to acquittal; but the district attorney's examination was very searching, and a stenographic report of the evidence secured; the statements were subsequently investigated, and perjury proceedings instituted.

This case was of more than ordinary interest in another way. One of the most persistent places for violating the law has been 122 South Main Street, Fall River, of which George Morrow was for some time the proprietor. He was convicted from time to time, until he deemed it prudent to "sell out." But the law continued to be violated, and the alleged purchaser of the store could not be found, while Morrow or some of his relatives were the only ones our inspectors ever saw in charge of the store. During the past summer 15 additional cases were brought for offences committed at this store, 4 against George Morrow, 2 against a brother and 8 against two brothers-in-law. All were found guilty in the lower court, and as one result a summons was served on the general agent of the Bureau as defendant in a civil suit for $5,000 damages, malicious prosecution being alleged, according to the local papers. Morrow, in the

superior court, after a long trial, was found guilty on 1 case and fined $500; 3 other cases in which he has been adjudged guilty are hanging over him for sentence. Brother-in-law Reed pleaded guilty to 6 complaints, and paid a fine in 1 case, 2 were continued for sentence and the others filed; the cases against the brother and one against Brother-in-law McCutcheon have not yet been reached in the superior court; the other case against Brother-in-law McCutcheon was the one above alluded to. Three appealed cases, with fines aggregating $450, against George Morrow have not yet been tried in the superior court.

Another old offender has been fined $500 in the Lawrence court, and there is a $300 fine hanging over the same person in the superior court.

Dr. Harrington, Boston's milk inspector, followed one slick, persistent violator of the law till the court imposed imprisonment.

The result of the enforcement of these laws in Massachusetts is that, according to figures submitted to Congress last winter, the consumption of imitation butter in this State last year was .73 of a pound per capita; while in the adjoining State of Rhode Island, where there is no law, the amount consumed was 8.45 pounds per capita. If we estimate the per capita consumption of butter or its imitations at 8 ounces per week, the amount consumed in a year would be 26.5 pounds, of which in Rhode Island a little less than one-third was counterfeit. It requires but little imagination to see the great injury which such a business in Massachusetts would cause to producer, consumer and middleman.

The number of persons who pay a United States tax, as shown by the following table, has some bearing on the effect of the law: —

Years ending June 30—	Wholesale.	Retail.
1891,	34	451
1892,	16	269
1893,	28	188
1894,	28	248
1895,	30	196
1896,	2	37
1897,	1	28
1898,	1	28
1899,	12	76
Present year,	3	59

The methods of the Bureau have been attacked in court on five points, which have been taken to the supreme court in the cases against Mullen, Suffolk County, May 17, and against Ryberg, Worcester County, October 18. Our practice has been vindicated on every point.

A statute of 1884 provided for certain marks on tubs, boxes and wrapping paper used in connection with sales of oleomargarine. The same act also provided certain details in regard to samples of milk. Section 4 of this act said that "before commencing the analysis of any sample the person making the same shall reserve a portion, and in case of a complaint against any person the reserved portion of the sample alleged to be adulterated shall upon application be delivered to the defendant or his attorney." Subsequent legislation provided other details in the milk law which led the supreme court to declare the above section 4 to be repealed by implication. The oleomargarine people maintained that the supreme court meant to say that only so much of the law as related to milk was repealed, and they insisted that the law was in effect when samples of oleomargarine were analyzed. The chemists of the Bureau, under instruction from the general agent, did not reserve portions of oleomargarine which they tested, as he claimed,

first, that the section of the law referred to was unqualifiedly repealed, and, second, if it was not, it did not apply to a law passed seven years after prohibiting traffic in an imitation product, because of its counterfeit nature, but where there was no allegation of any adulteration.

The supreme court said: "We do not see any sufficient ground for interpreting either section 4 as purporting to embrace samples that should be taken under future legislation or the act of 1891 as impliedly adopting section 4 of the act of 1884."

An objection was made to our form of complaint, on the ground that it did not contain the official title of the complainant, the general agent of the Dairy Bureau; it was also argued that inspectors of milk are the only officers authorized to make complaints. To this argument the supreme court said it is a sufficient answer that the same authority is plainly given to the representative of the Dairy Bureau. "As to the form of the complaint, if we should assume, for the purposes of decision, that only the persons named have authority to make complaints under the act, no doubt the office of the complainant should be alleged, but the defect at most is formal. Probably it would not be sufficient ground for a motion to quash. But the short answer to the whole matter is that the statute does not prohibit any person from making a complaint."

A third attack was the charge that our standard form of complaint "does not allege that the substance was not in a separate and distinct form, and in such manner as will advise the consumer of its real character." The court says: "This means that the complaint should have negatived the proviso that the act shall not be taken to prohibit the sale of oleomargarine in a separate and distinct form, etc., 'free from coloration or ingredient that causes it to look like butter.' The motion disregards these last words. The complaint alleges that the oleomargarine was in imitation of yellow butter produced from unadulterated milk or cream, and thus sufficiently shows that the proviso does not apply. The defendant had no right to keep such a substance for sale in any form or manner. Probably in any case it was unnecessary to negative the proviso."

The fourth point of attack was that the complaint "does not allege that said substance was renovated butter." The court says: "We presume that this should have read, 'was not renovated butter,' to express what was intended. It is not necessary, when charging a well-defined statutory offence, to explain that you are not charging another and quite different one."

The last ground of attack was that "the complaint is in the alternative when it alleges that the substance was made from adulterated cream or milk." To this the court says: "The complaint makes no such averment. It alleges that the oleomargarine was made partly out of an oleaginous substance not produced from unadulterated milk or cream, which is a very different allegation. If all the substances of which the subject matter of the charge was composed were produced either from unadulterated milk or from cream from the same, there would have been no offence under the statute in question; therefore both possibilities were negatived."

Another year's experience emphasizes our previously expressed opinions as to the dishonest nature of the imitation butter business and the deceptive methods used to bolster it up. Much has been said during the past few months, in connection with proposed legislation at Washington, the Grout bill, about the wholesomeness and food value of oleomargarine. Admitting, for argument's sake, that all these statements are true as to matters of fact, they are nevertheless deceptive in their application, because they attempt to befog an issue and deceive those to whom such claims are addressed. Water is wholesome, but add it to milk and its sale is prohibited; peas have a high food value, but when added to coffee the mixture is a swindle; lard and tallow are wholesome and have a food value, but when mixed and colored to imitate butter the compound becomes a counterfeit and a cheat. These oleomargarine laws are aimed at a commercial fraud. As District Attorney Rockwood Hoar said, in his brief in the Ryberg case, speaking of the anti-color law: "It relates to a deception addressed to the eye, and not the substance or component parts of the article."

Of a similarly deceptive nature is all of the talk about coloring butter which emanates from the defenders of oleo-

margarine. We do not defend coloring butter, — we wish such a custom did not prevail. But the practice deceives no one; a man who buys fresh creamery butter in December can hardly expect that he is buying June butter, — an inferior article. Butter is not colored to imitate another and more desirable article. But, even if we admit (which we do not) that these claims of the oleomargarine advocates are true as abstract statements of fact, what do they gain? When the law has its hands on pickpocket O, shall he be released and go scot free because he says C is also a pickpocket?

Dr. E. N. Eaton, the official analyst for the State of Illinois, in a recent article lays down this principle as governing the use of coloring matter in food products: "Harmless artificial coloring matter may be used for the sake of variety or uniformity, or in deference to the demand of customers, in goods where such coloring is not used to conceal inferiority, indicate strength or to imitate a higher-priced article." This dictum would allow the coloring of butter but not of oleomargarine, the coloring of which is "to imitate a higher-priced article."

The principle of the Massachusetts anti-color law has been several times reaffirmed in trade-mark cases. The latest was in a beer case, in which the defendant was enjoined from selling any beer under plaintiff's name and inscription, and also from selling "any *colorable imitation* thereof."*

Last year we called attention to the use of imitation rather than genuine butter in public institutions. Since then we have seen the report of one of these institutions in which we know this article is used. But the financial statement shows the purchase of only butter, and in the menus we find "bread and butter" several times, but nowhere "bread and oleomargarine." If the latter is so wholesome, has such food value, has so many virtues, why would not a bill of fare be rendered more attractive by the line "bread and oleomargarine?"

* Van Nostrand *v.* McGee.

Renovated Butter.

The flagrant attempts at violating the imitation butter laws have used so much of our appropriation that we could do little by way of enforcing the law in regard to renovated butter, although many notices have been sent to persons selling it, and no attempts at wilful violation have been found. This law is much misunderstood. The State does not interfere with the sale of this article, but asks that it shall be sold honestly, viz., properly marked or labelled. The "New York Produce Review" says: "The process of renovation impresses one as being cleanly and wholesome, and, while incalculable damage might result from an unscrupulous substitution of this product for genuine butter, its manufacture and sale under appropriate designating name must be regarded as beneficial to the butter industry as a whole."

This tells the whole story; all that the law asks is that the product shall be sold "under appropriate designating name."

Butter.

The Chamber of Commerce figures regarding the butter business in Boston for 1900 and the immediately preceding years are as follows: —

	1900. Pounds.	1899. Pounds.	1898. Pounds.	1897. Pounds.	1896. Pounds.
On hand January 1,	2,073,800	2,829,160	2,473,600	2,898,000	1,659,434
Receipts for the year,	51,502,840	49,757,606	50,609,552	51,107,033	50,972,255
Total supply,	53,576,640	52,586,766	53,083,152	54,005,033	52,631,689
Exports, deduct,	1,002,374	3,051,710	1,574,682	3,286,333	3,156,741
Net supply,	52,574,266	49,535,056	51,508,470	50,718,700	49,474,948
Stock on hand December 31, deduct,	3,285,960	2,073,800	2,829,160	2,620,680	2,898,080
Consumption,	49,288,306	47,461,256	48,679,310	48,098,020	46,576,868

The above shows increased receipts, reduced exports and increased consumption for 1900 over the four previous years. The increased consumption for the year over 1899 was 1,827,050 pounds. Such an increase could hardly have occurred had the sale of imitations been unrestricted. It is

hard to estimate the consumption of butter in Massachusetts, but with the above official figures for the Boston market it is safe to add one-half for the rest of the State. This gives us 74,000,000 pounds, which certainly is not an over-estimate. The consumption of oleomargarine, according to the United States internal revenue figures in 1899, was 2,083,899 pounds, — a very small amount in comparison with the total consumption of butter.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for six years: —

	1900. Cents.	1899. Cents.	1898. Cents.	1897. Cents.	1896. Cents.	1895. Cents.
January,	29.5	21.0	22.5	22.0	26.0	26.0
February,	26.0	24.0	21.5	22.0	24.0	25.0
March,	27.0	22.5	22.0	23.0	24.0	23.0
April,	21.0	21.0	22.5	22.0	22.0	21.0
May,	20.5	19.0	18.0	18.0	17.0	19.0
June,	20.5	19.0	17.5	16.0	16.5	20.0
July,	20.5	19.0	18.5	16.5	16.5	19.0
August,	22.5	21.5	19.5	19.0	17.5	21.0
September,	22.5	23.5	21.0	22.0	17.5	22.0
October,	22.0	24.0	21.5	22.5	20.0	23.0
November,	25.0	26.5	21.0	22.0	21.0	23.0
December,	25.5	28.0	21.0	23.0	23.0	28.0
Averages,	23.5	22.4	20.5	20.6	20.4	22.5

Although butter did not go as high in price during the fall months of 1900 as in the fall of 1899, it did better earlier in the year, and did not drop so low during May, June and July, — the months of flush production; so that the average price for the year is 1.13 cents more than for 1899, and is the highest average for six years. This explains the incentive to crowd the sale of fraudulent substitutes.

Milk.

The increased cost of milk production has caused much effort during the year to get better prices. These efforts have been successful in many instances, and in some places have resulted in a closer organization of producers. In the spring the farmers supplying the Boston market secured an

advance of 2 cents per 8½ quart can over the usual summer price for the six-months period from April 1 to October 1. This applied to 4,633,000 cans sold and 116,000 cans of surplus, and therefore meant an increased income to the farmers of $95,000. The amount came out of the middlemen, as no increase of retail price to consumers was made. In October the price for the winter six months was advanced 4 cents per can over the hitherto prevailing winter prices. This advance was so much that the dealers attempted to get it back by advancing the retail price. The movement resulted in such a remonstrance that the attempt was abandoned. Consequently the Milk Producers Union and the contractors agreed to the dropping of one-half of this advance January 1. This is the first time in the history of the business that there has been a change in the price during a six-months period.

The following table gives the receipts, sales and surplus of railroad milk, in 8½ quart cans, brought into the greater Boston, as reported by the contractors' association: —

1900.	Received.	Sold.	Surplus.
January,	808,699	762,437	46,262
February,	750,368	692,981	57,387
March,	868,440	800,825	67,615
April,	904,752	773,720	131,032
May,	1,019,632	784,209	235,423
June,	1,085,766	784,164	301,602
July,	978,872	810,989	167,883
August,	889,590	737,618	151,972
September,	845,995	744,623	101,372
October,	872,642	703,844	168,798
November,	799,122	678,788	120,334
December,	783,806	701,340	82,466
Totals,	10,607,684	8,975,538	1,632,146

	Receipts.	Sales.	Surplus.
1899, ...	11,234,764	8,911,971	2,322,793
1898, ...	11,317,761	8,564,682	2,753,079
1897, ...	11,798,191	8,738,572	3,059,619
1896, ...	10,772,108	8,087,378	2,684,730
1895, ...	9,856,500	8,040,732	1,815,768
1894, ...	9,705,447	7,657,421	2,048,026
1893, ...	9,263,487	7,619,722	1,643,765
1892, ...	9,212,667	7,315,135	1,897,532

This shows receipts less than for either of the four preceding years. The receipts for 1900 were less than for the corresponding month of 1899, except October and November. The sales for 1900 were the largest of any year on record. This gain was made in the first five months of the year and in September. In June, July and August the sales were 33,000 cans less than for the corresponding months of 1899. In October, November and December when the revolt against an increased retail price was going on, sales decreased 235,000 cans, making an increased surplus of 270,000 cans, for which the producers received butter value, — 14.91 cents per can in October, 16.43 cents in November and 17.52 cents in December.

The butter value of milk per can for 1900 was: —

	Cents.		Cents.
January, ...	19.34	July, ...	13.59
February, ...	18.00	August, ...	14.70
March, ...	17.93	September, ...	15.19
April, ...	13.22	October, ...	14.91
May, ...	13.95	November, ...	16.43
June, ...	13.50	December, ...	17.52

The Legislature of last year reduced the minimum fine for the first offence of selling milk not of standard quality. This was contrary to the best judgment of those engaged in enforcing the law, who believed that any letting down of

the bars would be no advantage to the milk business. The bars have been let down, however, with an emphasis in many cases, courts imposing a penalty of five, ten or twenty-five dollars, where formerly fifty dollars was the minimum fine. This shows a wide range between the judgment of the framers of the old law and of some of the district judges. But there is one advantage in the change: it is now much easier to get a record of a first offence, as a small fine is paid with less fighting and less appealing than a larger one.

Educational.

The educational portion of our work has been less during 1900 than during some previous years, for financial reasons. The general agent has responded to nineteen calls, involving the preparation of several papers. In the early history of the Bureau the Babcock milk tester was a novelty, and much work was done in familiarizing the dairymen of the State with its use by exhibiting it at institutes and making public tests of milk. Now that this, one of the most important products of the nineteenth century, is no longer a novelty, but has become one of the regular and indispensable appliances on hundreds of farms, this class of calls has grown fewer. Some work has been done in making milk dealers acquainted with the story the Babcock tester tells them. Fat being the variable element in milk, a test of the fat of normal milk will throw much light on the amount of total solids and of the standing of the sample tested in relation to the statute standard. One institute has been held during the year under the auspices of the Bureau; this was in connection with the Springfield Milk Dealers' Association. The food value of milk was the leading topic of the meeting, and a synopsis of some of the statements made at the meeting has been published as a Bureau bulletin.

The general agent of the Bureau is on call to address as many meetings as his other engagements will permit; especially would he be pleased to explain the work of the Bureau and what it is doing, thus bringing it into closer touch with the farmers of the State. The members of the Bureau will also respond to similar calls.

In view of the large milk-consuming interests of the

State, we have in previous reports called attention to the good which might be accomplished by some system of inspection of dairies, which would not be burdensome, and which would be helpful and educational, without any arbitrary or unpleasant features. We still hold to these suggestions, previously expressed. The general agent of the Bureau has been again called upon to award the dairy sweepstakes for the Worcester South Agricultural Society.

Laws may be enacted creating misdemeanors and imposing penalties, but real progress must rest on educational work as a basis. A law in advance of or in conflict with the average intelligence of a considerable portion of the people is a dead letter. Consequently this division of the work of the Bureau is very important, and deserving more attention.

Massachusetts Courts.

We desire to say one word in commendation of some features of the Massachusetts system of criminal courts, particularly the local district and police courts. In many States the dairy commissioner, or other officer entrusted with the enforcement of the dairy laws, on securing evidence of violation of law turns the case over to the public prosecutor (State or district attorney), and the case gets into court only on a grand jury indictment. In Massachusetts all cases are first tried in the local court, being prosecuted by the department bringing the complaint. These cases go direct to the superior court if appealed. Only appealed cases are prosecuted by the district attorney, and even then, under our Massachusetts custom, the administrative head of the department where the cases originate follows them up and is of material assistance to the district attorney, not only in laying before him the evidence in the case, but in bringing to his attention the points raised in the lower court and the result of experience in other counties. All this tends to promote the efficiency of the enforcement of the law in Massachusetts. In Pennsylvania, for instance, where there has been some public criticism of the administration of the office of dairy commissioner, his defence was that his work had been faithfully done, but that for any failure to bring the parties into court the district

attorney was responsible. The commissioner says, in his last report: "The commissioner, or his attorneys, have no more power over the case at this stage of proceeding than any other citizen. All that they can do is to wait the pleasure of the district attorney and the court. If these officers decline to bring the cases before the grand jury and list them for trial, the prosecution has no remedy. They are effectually blocked as to any further progress. All of the cases that are now pending are in exactly this situation. They have been urged as far as the commissioner and his attorneys can prosecute them, and now it is simply a question of when the courts will take them up."

Another advantage of the Massachusetts system is that it gives the prosecuting officer a more thorough familiarity with every phase of his work than otherwise would be possible, and it gives him a breadth of experience such as is vouchsafed to few, if any, who hold similar positions in other States. Take, for instance, the past year: the experience of the general agent of the Bureau has included such an investigation of the methods and details of the imitation butter business as has culminated in 178 cases for court; it has also included the actual trial of those cases in the lower courts, and a very close touch with such as have been appealed to the superior courts. This exceptional breadth of experience is sometimes recognized in a way complimentary to the State by calls upon him to address meetings out of the State and to explain the work of the Bureau. Last summer he represented the State and its agricultural department with a paper at the Farmers' National Congress at Colorado Springs (at his own expense). Later he was given an honorable place on the programme at the national convention of dairy and food departments of the different States, held at Milwaukee, Wis. He was also emphatically urged to appear before the committee on agriculture of the National Senate, at a hearing on the Grout bill, to give some account of the experiences of the Dairy Bureau in enforcing the imitation butter laws of Massachusetts. These invitations he was unable to accept, on account of other duties. We believe that it is well for the Commonwealth to be represented occasionally, within reasonable limits and when funds allow,

at national gatherings. It not only gives the Commonwealth a recognition and standing among other States, but an interchange of ideas and acquaintance with others doing similar work promotes the general efficiency of the cause. Massachusetts already stands high among other States in the matter of dairy legislation. Since the Plumley decision, which was so largely due to the great ability and skill of former Attorney-General Hon. A. E. Pillsbury, between twenty-five and thirty States have patterned after our anti-color law; California has a Dairy Bureau; and now Maine is contemplating organizing a Dairy Bureau of its Board of Agriculture, patterned after the Massachusetts Bureau. In addition to the above calls out of the State, the general agent of the Bureau has, as a representative of the department, addressed the Vermont Dairymen's Association and a dairy conference of the Maine Board of Agriculture.

Financial.

The following is a classified statement of the expenses of the year: —

Members of the Bureau, travelling and per diem for attending meetings,	$262 94
Educational work,	136 27
Inspectors' salaries,	1,632 00
Inspectors' expenses,	2,444 96
Chemists,	1,664 60
Geo. M. Whitaker, travelling expenses, postage, express, telegrams, etc.,	797 92
Printing and supplies,	61 31
	$7,000 00

GEORGE M. WHITAKER,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

J. LEWIS ELLSWORTH.
CARLTON D. RICHARDSON.
FRED W. SARGENT.

ANNUAL REPORT

OF THE

Board of Cattle Commissioners

OF THE

Commonwealth of Massachusetts.

January 9, 1901.

REPORT.

To the Honorable Senate and House of Representatives.

The Board of Cattle Commissioners herewith presents its annual report, as required by section 3, chapter 408, Acts of 1899, of the work it has performed during the past year.

The Legislature of 1900 appropriated the sum of $50,000 for the expenses of the commission in dealing with the contagious diseases of animals. This sum has proved insufficient for carrying out the law, and all cattle quarantined after the 1st of December were released for lack of funds.

In order to have this report ready by the 10th of January, it is necessary for the commission to close its books the 15th of December; that is, the annual report of the Cattle Commission involves the period between December 15 of one year and December 15 of the following year; therefore, while the report shows a balance on hand December 15 of about $4,300, when the bills against the commission all come in, January 1, it is feared that there will not be funds enough on hand to meet them, and that a small deficiency will be the result, which will probably amount to a little over $3,000.

As work had to be closed December 1, leaving forty or fifty diseased cows to be looked after another year, and as the work done during the past year has been only that which was in the main absolutely imperative, the commission finds that it will require an appropriation to be placed at its disposal this year of $75,000, in order to properly carry out the provisions of the law which it has to administer. This amount will be necessary to meet the expenses incurred in dealing with tuberculous cows reported by the local inspectors of animals, keeping up the quarantine regulations requiring healthy cattle to be brought in from other States, examining and killing horses with glanders or farcy, investigating and limiting outbreaks of hog cholera and rabies, and incident-

ally inquiring into any other outbreaks of disease reported to it, thought to be of a contagious character.

In dealing with tuberculosis among cattle, the commission feels that, in taking animals that can be condemned upon a physical examination or that have tuberculous udders, it is protecting the public health and giving the State a good system of inspection of dairy herds, but that it is little more than holding its own against the disease, and not diminishing it as rapidly as could be desired. Many farmers would like to have their herds freed from disease, but in most instances it has been necessary to refuse for lack of funds, and when it has been done, the conditions imposed seem to have been too onerous for many farmers to bear.

It does not seem unwise, therefore, to suggest the advisability of a special appropriation, in addition to that absolutely necessary for administering the law, to be used for testing the herds of cattle of owners who request it, paying for animals found to be diseased, such owners being willing to comply with the requirements of the Cattle Commission in disinfecting their premises and keeping their herds healthy after once rendering them so. If an appropriation of $25,000 could be placed at the disposal of the Cattle Commission for this purpose, it is believed that in some localities very material advances could be made toward further diminishing the amount of bovine tuberculosis in this Commonwealth.

An inspector of animals has been appointed in every city and town in the State during the past year, nearly all of the appointments being approved by the Board. In two or three instances appointments were made of persons who were not thought by the commission to be suitable for the position; in these cases it declined to approve them, as provided for in the law, and requested that inspectors be appointed who were properly qualified for these offices. The selectmen of one town declined to make an appointment after the commission refused to confirm its appointee; the Board accordingly appointed an inspector of animals for them, as provided for under section 18 of chapter 408, Acts of 1899. In one of the cities the Cattle Commission appointed an inspector of

animals. The board of aldermen refusing to confirm the mayor's appointment, the mayor requested the commission to make an appointment, as he and the aldermen could not agree on a suitable person; this was therefore done.

The inspectors have done very much better work during the past year than they did the year before; only four have failed to make the annual report required of them, and two of these had good excuses; while in 1899 the inspectors of animals in twenty-three cities and towns neglected to make the reports they should have made.

New books were furnished the inspectors last year in which to make their reports, and perhaps one reason for having reports from more towns is due to the books being simpler and the blanks in them more easily filled out. Formerly the inspectors were furnished with a book in which to record the results of their herd inspections and another in which to record the results of the inspection of stables and premises; now one book is sent, having spaces to fill out, answering questions relative to the animals and premises all on one page; and the questions asked are fewer and simpler, making the inspectors' task lighter, while the results arrived at are the same.

The commission takes this opportunity of renewing its thanks to Dr. Theobald Smith, professor of comparative pathology at Harvard University, for the valuable advice and assistance he has ever been so ready to render when they were needed.

The laboratory work required by the commission during the year 1900 has been performed as usual by Dr. Langdon Frothingham at the bacteriological laboratory of the Harvard Medical School, except when he was on his vacation, when Dr. John N. Coolidge took his place. Their services have been fully appreciated, as have also the facilities granted the Board at the Harvard Medical School.

Financial Statement.

During the year ending Dec. 15, 1900, there has been expended by the Cattle Commission, under chapter 408, Acts of 1899, as follows: —

Paid for cattle condemned, killed and found tuberculous, 1,423 head,	$30,870 22
Paid for cattle condemned, killed and no lesions found, 43 head,	886 33
Paid for quarantine expenses, 17 head,	24 15
Paid for expenses of killing and burial,	11 50
Paid for arbitration expenses,	1 00
Paid for salaries of commissioners,	5,740 00
Paid for expenses of commissioners,	2,227 07
Paid for services of agents,	7,390 57
Paid for expenses of agents,	3,130 61
Paid for clerks and stenographers,	2,608 50
Paid for postage, stationery, printing and other office expenses,	1,206 71
Paid for expenses of laboratory and experimental work,	981 99
Paid for expenses of quarantine stations,	2,733 79
Paid for expenses of glanders, killing and burial,	209 00
Paid for tuberculin and implements,	184 29
Total,	$58,205 73

Of this amount, there was paid for 1899 accounts $12,573.52, leaving balance paid for expenses of current year to December 15, $45,632.21. The average price paid for the 1,466 head condemned was $21.66. During the year there has been received and paid to the State Treasurer, proceeds from sales of hides and carcasses of condemned cattle, $791.78.

Tuberculosis.

As in previous years, the chief cause of expense in eradicating the communicable diseases of animals has been in connection with bovine tuberculosis, and more animals have been condemned and killed on account of this affection than any other; hence it is given the first place in this report, although it can hardly be considered of greater importance than glanders under existing conditions, or than rabies at times when this disorder is very prevalent.

The management of tuberculosis, as in former years, may be divided under three general heads: —

First. — The maintenance of quarantine regulations against other States, requiring that all cattle imported into Massachusetts for dairy or breeding purposes shall be free from tuberculosis, their health being based upon their being able to pass the tuberculin test. The owner may have them

tested by a veterinarian satisfactory to the Cattle Commission before shipment, or after arrival at their destination, at his expense and risk.

Second. — That portion of the work called for by the quarantining of manifestly diseased animals by the local inspectors.

Third. — Testing entire herds at the request of the owners, with a view to permanently eradicating tuberculosis from them.

First. — The maintenance of quarantine regulations will first be considered.

All cattle brought into the quarantine stations at Brighton, Watertown and Somerville remain in quarantine until released by the commission. All persons bringing cattle from without the Commonwealth into these stations are required to bring with them certificates of test made by competent veterinary surgeons, the cattle to be tagged in the ear, and said tag number must correspond with the number upon the certificate. If any fail to have such certificate and tag, they are held until tested with tuberculin and released or condemned by the commission.

The following tables will show the amount of stock received at these stations during the year: —

Receipts of Stock at Brighton, from Dec. 15, 1899, to Dec. 15, 1900.

Maine cattle,	11,203
New Hampshire cattle,	1,689
Massachusetts cattle,	12,290
New York cattle,	917
Connecticut and Rhode Island cattle,	436
Western cattle,	81,498
Vermont cattle,	656
Sheep,	25,314
Swine,	681,694
Veal,	39,797
Cattle released on certificate,	9,354
Cattle tested,	495
Cattle released after test,	490
Cattle condemned and killed after test,	5
Massachusetts cattle in stock barn,	16,969

Receipts of Stock at Somerville, from Dec. 15, 1899, to Dec. 15, 1900.

Maine cattle,	1,432
New Hampshire cattle,	5,217
Vermont cattle,	5,027
Massachusetts cattle,	3,422
New York cattle,	605
Western cattle,	10,819
Sheep,	326,738
Swine,	17,610
Veal,	52,896
Cattle released on certificate,	1,567
Cattle tested,	7
Cattle released after test,	7

Receipts of Stock at Watertown, from Dec. 15, 1899, to Dec. 15, 1900.

Vermont cattle,	4,578
New Hampshire cattle,	5,097
Massachusetts cattle,	3,007
New York cattle,	26
Western cattle,	44,338
Sheep,	355,585
Swine,	585,567
Veal,	53,169
Cattle released on certificate,	6,122
Cattle tested,	131
Cattle released after test,	129
Cattle condemned after test and killed,	2

Total Amount of Stock at the Three Stations.

Cattle,	192,257
Sheep,	707,637
Swine,	1,284,871
Veal,	145,862
Released on certificate,	17,043
Tested at stations,	633
Released after test,	626
Condemned after test,	7

This year more cattle have been brought to market without certificates than in any year since 1896. There have been tested by the commission 633 cattle, 7 of which number have been condemned, killed and found to be tuberculous, — a little over 1 per cent.

In 1896 there were 501 cattle tested at the stations, of which number 18 were condemned, killed and found to be diseased, — $3\frac{3}{5}$ per cent.

There has been a steady decrease in the per cent. of cattle condemned each year, from $3\frac{3}{5}$ in 1896 to 1 per cent. in 1900, which is due largely, we think, to the care and good judgment the drovers exercise in selecting their stock, as they report that there are certain sections of some States in which they do not care to buy cattle for this market, owing to the prevalence of tuberculosis.

We believe that if the present quarantine restrictions were removed there would not be such care taken on the part of the drovers, and many diseased animals would be found in Brighton market and also all through the Commonwealth from those districts; therefore we believe the quarantine should be made more stringent along the border lines, and great care taken to protect the citizens and herds of the State from this disease.

It will be seen that, out of a total of 192,257 head of neat stock, 17,669 were released as free from disease; these were nearly all milch cows for the local market; the remaining 174,588 were for slaughter or export.

In addition to the above, there were 636 permits issued and 4,765 dairy cattle were brought into the State, also 16 calves. Of these, 3,120 were tested before shipment and 1,614 after arrival in this State. Some cattle were returned from pasture during the year, and a good many beef cattle were brought in for slaughter, the exact number not being recorded. Of these 1,614 cattle tested after arrival, 22 reacted to the test and were disposed of as follows: 6 were returned to the State from which they came; 15 were killed and found tuberculous; and 1 was killed and paid for, because no lesions were found.

The following extract from a paper, read by the chairman of the Board of Cattle Commissioners at the annual meeting of the American Veterinary Association, at Detroit, last September, will give an idea of the difficulties the commission has met with in enforcing its regulations: —

Obstacles to enforcing Regulations requiring the Tuberculin Test in Inter-State Cattle Traffic.

Massachusetts was among the first States, if not the first State, requiring cattle brought within her borders to be kept for dairy or breeding purposes to be subjected to the tuberculin test, although for several years prior to the use of tuberculin as a diagnostic agent Maine had maintained a quarantine against all Massachusetts cattle, because of the prevalence of tuberculosis in the old Bay State.

In 1894 the Massachusetts Legislature passed an act providing that owners should be reimbursed by the State for one-half the value of cattle killed by order of the Cattle Commission as having tuberculosis. In 1895 the law was amended so as to provide that owners should be paid full appraised value for tuberculous cattle up to a limit not exceeding $60 for any one animal. In 1899 this limit was reduced to $40, the appraisal to be based upon the actual market value of the animal for milk or beef purposes at the time of condemnation, breeding not being considered. No compensation, however, is allowed for a diseased animal that has not been owned continuously within the State for six months prior to the time of condemnation.

It was during 1894, also, that the Cattle Commission commenced using tuberculin on a large scale as a diagnostic agent, killing all reacting animals. It was at once obvious that, if the State was to undertake the extirpation of bovine tuberculosis, only healthy animals should be brought into the Commonwealth to replace those killed, and that their condition of health must be based upon their standing the tuberculin test. Massachusetts does not raise a great deal of neat stock; the supply of milch cows is brought in largely from without the State, especially at the eastern end, where the milk producers depend almost entirely upon new purchases brought in from other States to keep up their dairy stock. These cows come largely from Maine, New Hampshire and Vermont, quite a number come from New York State and a few from other places.

Every Wednesday a large cattle market is held at Brighton, a suburb of Boston, at which there are often 700 or 800 cows. Of these, 200 to 250 come from Maine, 100 to 125 from New Hampshire, as many more from Vermont and a carload or two from New York State; these are practically all new milch cows. The rest come from Massachusetts, many of them brought in by milkmen to sell because they are farrow, gargetty or otherwise worn out, most of them being sold for cheap beef or bolognas, their

owners replacing them with fresh stock, mainly from the northern New England States.

There are about 20,000 head of cattle from without the State (not counting beeves), mainly milch cows, passing through Brighton market each year; most of them remain in Massachusetts, quite a number go to Rhode Island and a few are taken to Connecticut. The Cattle Commission, therefore, in the autumn of 1894 issued regulations requiring all persons bringing cattle into Massachusetts to have a permit unless brought to the stock yards at Brighton, Watertown or Somerville, which were designated by the Board as quarantine stations, and requiring all cattle, except beeves for immediate slaughter and calves under six months old, to be subjected to the tuberculin test.

Commencing Nov. 21, 1894, the cattle arriving at the stock yards were held in quarantine and tested by the commission, all reacting animals being killed. Of course, under the law there is no compensation for a tuberculous animal that has not been owned in the State for six months; but if an animal killed by order of the commission is found free from disease, the State has to pay its full value to the owner.

Under the method first adopted it was found that quite a number of animals gave an apparent reaction to tuberculin, which when killed showed no lesions of disease, and therefore had to be paid for, making the work quite expensive for the State. This was due to the fact that many cows, as the result of the excitement of transportation and strange surroundings, would have a rise of temperature the day after arriving, that could easily be mistaken for the rise of a tuberculin reaction. The cattle trains arrive early Tuesday morning; the cows are unloaded and given twenty-four hours to rest and bag up, and are placed on the market Wednesday. Wednesday has been market day at Brighton from time immemorial, I was going to say; at least, it probably has been ever since there was a market at Brighton. In order to give the cattle time to rest and recover from the effects of transportation, the Cattle Commission had market day changed to Thursday, the cattle being tested Tuesday evening and temperatures taken Wednesday; even this was not satisfactory.

It was then proposed that the cattle should be brought down a week ahead, — that is, cattle intended for sale one week should be brought down the preceding week and held in quarantine six days, and then tested. This plan would have entailed an extra expense that the drovers could not have stood, as it would have upset their plans and cut into their profits to an extent that would have driven them out of business. After testing the cattle at Brighton from

Nov. 21, 1894, to April 30, 1895, with the drovers fighting, objecting and placing every obstacle in the path of the Cattle Commission that they possibly could, the work was temporarily abandoned. In July, 1895, it was decided that milch cows and breeding stock coming into Massachusetts must be tested, but that each drover could employ a veterinarian to test the cattle before shipment, the examiner to make out a certificate of tuberculin test on blanks furnished by the Cattle Commission. These blanks are made in duplicate, the animal described therein is identified and released by a member of the commission at the stock yards, who gives the owner the original and keeps the duplicate to file away, where it can be referred to at any time if a question concerning a particular cow arises. At the present time each cow is required to have an ear tag (furnished the drovers at cost by the commission), the ear tag number and certificate number having to correspond; this makes the identification of each animal more easy.

The drovers entered readily into this plan, and each arranged to have a veterinarian in his locality test his cattle. The Cattle Commission obtained a list of veterinarians from the commissioners of the other States, whom they considered reliable; the intention at first was to have only veterinary graduates upon it, and only those vouched for by Cattle Commissions of their respective States. In some localities there were no qualified veterinarians, and it was arranged to accept tests of members of the laity who were practical cattlemen, castrators and the like, and who familiarized themselves with the proper methods of applying tuberculin. This work was done honestly, probably, for a few months; then crooked work commenced, and has been carried on to a greater or less extent by some men ever since. (An honest quack is better than a dishonest graduate.)

This plan has been followed now for five years. The animals brought to the stock yards each week need no permit; the cow dealers give the certificates of tuberculin test (often fake ones) to the commissioner having charge of this branch of the work, who identifies and releases the animals. Cattle brought to any other points can come in only on permits, and if over six months old and for dairy or breeding purposes must be tested either before shipment or after arrival at their destination, at the expense and risk of the owner. If any cows are brought to the stock yard quarantine stations untested, they are held and tested in five or six days, in time to go on to the market the next week. Any that react are killed; if slightly diseased, the owner can have what the butcher will allow him for the beef; if badly diseased, the carcass

is tanked. If the commission makes a mistake by killing a healthy animal, it pays for it.

Since 1894 and 1895 many other States have adopted regulations based upon those of the Massachusetts Cattle Commission. The Bureau of Animal Industry of the United States Department of Agriculture requires all cattle held at the government quarantine stations to be tested with tuberculin if over six months old. The Canadian government also requires neat cattle brought into Canada to have a certificate of tuberculin test made by a government veterinarian in the country from which they are shipped; in the absence of this, they are held and tested at the quarantine station at the port of entry.

One would suppose from this that the State of Massachusetts had a right to adopt such rules and regulations as were deemed necessary for the protection of her live stock interests, yet the commission has had a steady fight on its hands for the last six years with the cattle dealers and drovers.

The regulations regarding the cattle traffic in various States differ somewhat. In Massachusetts the law gives the Cattle Commission power to issue all necessary rules and regulations for the protection of the live stock interests of the State; the same is true of Vermont, New Hampshire and Colorado. In some of the other States the governor issues a proclamation upon the recommendation of the live stock sanitary boards; Illinois, Texas, Wisconsin and several other States are examples of this method. In Maine the Board of Cattle Commissioners may issue the necessary rules and regulations, subject to the approval of the governor.

In some States the importation of cattle is regulated by the Public Statutes; examples of this are Rhode Island, Connecticut, New Jersey and Pennsylvania. This legislation may favor the tuberculin test, or may be directly opposed to it, and may even be carried so far as to show a distinct animus against the veterinary profession. The State of Connecticut is the most striking example of this feeling.

Rhode Island has an intelligent and conscientious Cattle Commission, the secretary of agriculture acting as its secretary, with a commissioner from each of the six counties, an appraiser and a consulting veterinarian. Until this year the law of Rhode Island provided as follows: —

[Chapter 342, Acts of 1896.]

Section 2. All persons, corporations or companies intending to ship, transport or drive cattle into the state, must produce a certificate to the effect that the cattle to be so shipped, transported or driven are free from tuberculosis as far as may be determined by physical examination and

the tuberculin test. The certificate shall give a description of each animal brought into the state, sufficiently accurate for identification, and shall also give the date and place of examination, the preparation of tuberculin used, the quantity injected, the temperature immediately before inoculation, the temperature at the eleventh hour and every two hours subsequent thereto, for at least ten hours, or until the reaction is completed. The certificate shall be signed by a veterinarian who is a graduate of a recognized veterinary college, and shall be sent immediately to the secretary of the state board of agriculture, who shall immediately notify a commissioner of the county into which the cattle are to be shipped, transported or driven, and said commissioner shall examine the cattle to identify them. Failure to comply with the law shall be considered a misdemeanor punishable by a fine not to exceed one hundred dollars.

SECTION 3. Complaint for the violations of the provisions of this chapter shall be made to the secretary of the state board of agriculture, and said secretary shall be exempt from giving surety for costs on any complaint made as aforesaid.

From an intelligent stand-point this would seem to be a good law, and one which ought to have been left alone; but the Rhode Island Legislature of 1900 passed the following amendment: —

[CHAPTER 756, ACTS OF 1900.]

SECTION 1. All persons desiring to import cattle into this state or from other states without obtaining the certificate required by section two of chapter three hundred and forty-four of the public laws, shall give written notice to the cattle commissioner of the county into which the cattle are brought within forty-eight hours after the arrival into the state of such cattle; and such notification shall contain a specified list of the cattle so imported, with a full description of age, sex, and such other particulars as may be necessary for the identification of the said cattle and the place where they can be found.

SECTION 2. Immediately upon the receipt of such notification the cattle commissioner of the county into which said cattle are imported shall proceed within seventy-two hours to the place designated and make a physical examination of said cattle; and if upon such examination said cattle shall be deemed free from tubereulosis, it shall be so certified by said cattle commissioner upon a permit, and a duplicate thereof be given to the owner of said cattle, and the cattle shall be released for the use and benefit of the owner.

SECTION 3. If after such examination the cattle commissioner shall be of the opinion that the cattle so examined are afflicted with tuberculosis, he shall require of the importer that the suspected cattle be tested with tuberculin, said test to be applied by a veterinarian of a recognized veterinary college, who shall give to the said commissioner a certificate in writing that such test has been applied, together with a statement of the tuberculin used, quantity injected, temperature of each animal before inoculation and at the eleventh and every two subsequent hours there-

after, for at least ten hours, or until reaction is complete; and a duplicate thereof shall be given to the owner of said cattle, and the original certificate shall be sent by the said commissioner to the secretary of the state board of agriculture. If after such test it shall be proved that such suspected cattle are afflicted with tuberculosis, such diseased cattle shall be immediately slaughtered, upon written order of said commissioner, and the state shall not be required to compensate the owner for their loss, and the owner shall pay for testing such cattle with tuberculin; but if such cattle shall be found free from tuberculosis they shall be released for the use and benefit of the owner. If any of such cattle are slaughtered, and upon post-mortem examination it shall be found that the slaughtered animal was not afflicted with tuberculosis, then the animal so killed shall be paid for by the state at the full appraised value, in accordance with the provisions of section eleven of chapter ninety-nine of the general laws.

SECTION 4. Any person violating any of the provisions of this act shall be deemed guilty of a misdemeanor, and shall be fined not more than one hundred dollars.

SECTION 5. This act shall take effect from and after its passage.

It can be readily seen that this law is intended to counteract that of 1896, and was passed in the face of the opposition of the Rhode Island Cattle Commission and all intelligent argument that could be brought to bear against it. This is another example of obstacles to the tuberculin test on the part of the cattle men.

On the other hand, Pennsylvania and New Jersey have very good statutes for the protection of their live stock interests, providing that all persons and corporations must have permits to bring cattle within their limits, and that cattle for dairy and breeding purposes must be tested with tuberculin before shipment, by reliable veterinarians, or else be held in quarantine and tested after arrival at their destination.

Probably legislation such as has been enacted in Pennsylvania and New Jersey is more efficacious for the protection of the live stock interests of a State than the power to make rules and regulations given to cattle commissions or live stock sanitary boards; because, first, there is more respect for statute law than for the rules and regulations of a commission; and, secondly, the courts will take more interest in enforcing the law than they will in imposing penalties for breaking rules and regulations formulated by a commission.

The Massachusetts Cattle Commission has been impeded and imposed upon in every possible way that many of the drovers could devise. Most of the dealers undoubtedly thought, when these regulations were first adopted, five years ago, that tuberculosis was a fad and a temporary matter, that it was of little importance and that tuberculin did not amount to anything. A

farmer in one of the northern New England States does not like to sell a cow subject to the test, and have her left on his hands if she reacts; the drover does not like to buy a cow out and out, and have her react, because he has to sell her at a loss near home, her value being diminished if she turns out to be an animal he is not allowed to bring into Massachusetts. The result has been that a number of the dealers have done their best to corrupt the veterinarians or alleged veterinarians making the tests, and induce them to make out certificates without using tuberculin at all, and in many instances have succeeded in doing so. When the Massachusetts Cattle Commission finds that a man is doing dishonest work, it refuses to accept his tests, and the drover then has to find a new man, and, if possible, corrupt him. There have been a few exceptions to this rule, when the culprit has acknowledged that he has done wrong, and has promised to turn over a new leaf when the disgrace of his dishonesty has been pointed out to him, and he has been reinstated.

In localities where an occasional carload of cows is shipped into Massachusetts I think that the testing has been in the main properly done; but where the cattle are shipped every week, as they are from certain points in Maine, New Hampshire and Vermont, corrupt methods have developed. Two years ago last spring the Massachusetts Cattle Commission had a list printed of men whose tests it would accept, after dropping a number of names from the old list, and it is now time to prepare a new one; the chief reason for delay is the fact that just when it seems that the names of only reliable men are ready, it is found that another good man has gone wrong.

Another reason for dishonest work, in some instances, is due to competition among the veterinarians, who cut prices in order to obtain a certain drover's patronage, until they reduce the price to such a rate that a man cannot afford to test the cattle and use tuberculin, and so makes out the papers without the formality of a test. This has been a very foolish cause for this kind of work, as there are so few men on the list now that they could all agree to a good price, and obtain it.

Occasionally a tuberculous cow may be honestly tested and fail to react, — that is, she may be tested by a man one week and refused a certificate; and then the owner may have another veterinarian test her the following week without informing him that she has reacted once, and thus obtain a certificate of health because she fails to react when tested the second time; or a drover may have a cow of which he is suspicious, and himself inject her with a heavy dose of tuberculin, and when she recovers have her tested

by the veterinarian. Occasionally a badly diseased cow may fail to react, but these cases ought to be perceptible from the physical condition of the creature; but when a man is testing a large number, and has gotten into the habit of depending entirely on tuberculin, he may overlook such a case. In my experience, a cow's failing to react to a second test made soon after the first one is not as frequent as many persons believe; in the majority of cases an animal that has given a marked reaction once is very likely to react again.

Numerous specific instances of dishonest work might be given. Last autumn an Ontario graduate, supposed to be one of the leading veterinarians of New Hampshire, was called to Dracut, Mass., to test a cow just brought in from across the line, held in quarantine until a certificate of test was sent in. Soon after, suspecting that all was not right, I proceeded to Dracut, and went with the inspector of animals to see about releasing the cow. I asked the owner if she had been tested. He said: "Oh, yes; the man came and stuck the tubule right into her; took it out of his pocket and stuck it in." Asked how long he was there and how many times he called, he said he "only seen him once, and he was only there a few moments." All he had done was to take the cow's temperature, make a physical examination, and then give a certificate of tuberculin test. The cow failed to pass when properly tested later. This veterinarian called to see me, and denied that he ever did such a thing before, but acknowledged his transgression in the case I caught him on, and said he would be very careful in the future. The words were hardly cold from his mouth before he was called upon to test a lot of cows to be sold at auction in southern New Hampshire, some of which might be brought into Massachusetts. A number were brought in with his certificate and held by the commission and tested; several reacted, showing that they either were not tested properly or probably not at all. It is needless to say that his tests will not any longer be accepted by our Board. This is only one example of a number that I might give.

Early in June a large Jersey breeder in Pennsylvania had Dr. Francis Bridge test a number of cattle he intended selling at auction, and sold them with his certificates. A neighbor was going to have an auction of Jersey cattle at about the same time, and he thought it would be a favorable opportunity to have Dr. Bridge test his. I believe there was quite a large number, — over one hundred, if I am correctly informed, — and some twenty odd failed to pass, and Dr. Bridge refused to give certificates. The owner had a local veterinarian test the cattle, who gave certificates

on some, if not all, and they were sold at the auction with the other man's certificate. At the sale the statement was given out that Dr. Bridge did not test all the animals, as quite a little bunch was overlooked until after he had gone, and therefore they had been tested by another doctór. Several cattle from this sale were brought into Massachusetts, but all had been tested by Dr. Bridge. If any tested by the other man had been shipped into the State they would have been held and retested by the Cattle Commission, with, I believe, interesting results.

The Bureau of Animal Industry is in the best position to obtain honest tuberculin tests, as it holds the cattle in quarantine at the port of entry and has its own agents to test them, and therefore knows the work is honestly done.

The greatest obstacle to the enforcement of laws or regulations requiring a tuberculin test in the inter-State cattle traffic is dishonesty.

First, there are the avarice and lack of honesty among some cattle dealers and drovers, which lead them to object to the test, because it interferes with their profits.

Secondly, the dishonesty of certain veterinarians, who disgrace and dishonor a profession which should be a useful and honorable one, by claiming to be members of it.

Possibly there is more excuse for the cattlemen, as many of them think tuberculin is a humbug, that the test is of no value, and that these regulations are a passing fashion, — not come to stay. I do not wish it to be understood that I regard all our cattle dealers and drovers as dishonest or dishonorable, as there are a number of men among them of the strictest integrity and reliability, but it is greatly to be deplored that many of them are not.

The veterinarians ought to know better than to do dishonest work, and should be glad to co-operate with the authorities in any State in diminishing a scourge to the farmer, even though too many farmers are so ignorant and short-sighted as to fail to appreciate what is being done for them. As to the danger to the public health, I think that is a matter that has been overestimated. The attempt to terrorize the community with the dangers of the use of dairy products on account of tuberculosis, by certain veterinarians whom the people have suspected of wanting salaries, has done much to cause a reaction against the work and to lead to a lack of confidence in the profession, such as is so well exemplified in the legislation already alluded to in the State of Connecticut. Much of the trouble seems to be due to a lack of honesty among certain dishonorable members of the profession.

What other remedy there is, except refusing to accept their tests, I do not know. They ought certainly to be expelled from any veterinary associations to which they belong, although most of the offenders belong to a class that do not join associations. Dealers and drovers or breeders who sell cattle with fake tests ought to be prosecuted for obtaining money under false pretences; and a breeder who will do such a thing ought to be expelled from any breeders' association, and his cattle ought to be refused registry in the herd book.

A lack of honesty seems to be a national failing. Parents should bring up their boys to realize that it is a sin and a disgrace to steal, and that "a lie is an abomination to the Lord." Our veterinary schools should lay greater stress on professional integrity than at present; and if some means could be devised for disciplining the rascals, even to revoking their diplomas, if that is possible, it would be a benefit. "Honesty is the best policy;" but my experience with men has been that a man who is not honest as a matter of principle is not very likely to be so as a matter of policy.

Other obstacles to the enforcement of regulations requiring the tuberculin test may be carelessness on the part of railroad companies in seeing that a shipper to a point outside a quarantine station has a permit. It occasionally happens that a freight agent may accept a shipment of cattle from a man who has not secured a permit, without notifying the authorities in the State to which the cattle are shipped. This can be remedied by reporting the local freight agent to the general freight agent of the road, whenever such an instance is heard of; and in time the work will be so perfected as to have no such infringement of the rules, as they are broken more from not understanding them than from any direct intention to disregard the law.

Another obstacle that will always exist on a small scale is the trading back and forth of cattle by farmers in adjoining towns located in different States; but the number of animals exchanged in this way is limited. The necessary rules or laws may be enforced here to a certain extent, but there will always be a number of instances where they will be quietly disregarded.

I have necessarily confined myself chiefly to the condition of affairs in New England, and more especially to Massachusetts, as this is where my personal experience lies; but what I have said will probably apply to a certain extent to other sections, and it may be that the trials we have been called upon to endure may result in making it easier for others later.

Second. — The quarantining of cattle by the local inspectors, because there is reason to believe that the animals are diseased. Most of them were found on the general inspection, although there were a few cases reported at intervals during the year, chiefly upon complaint of the owner to the inspector of animals in his town.

It is provided by section 29, chapter 408, Acts of 1899, as follows: —

It shall be the duty of inspectors, in addition to their inspections of animals for contagious diseases, to examine the barns, stables or other enclosures in which neat cattle are kept, with reference to their situation, cleanliness, light, ventilation and water supply, and the general condition and cleanliness of the said neat cattle, and to make a detailed report, with names and residences of owners, to the board of cattle commissioners, who shall embody the same in its annual report to the legislature.

In accordance with this provision of the law, the following order was issued to each inspector of animals: —

BOSTON, Oct. 1, 1900.

———, *Inspector of Animals.*

The Board of Cattle Commissioners hereby directs that you shall make a general inspection of the neat stock in your town, and incidentally other farm animals, to commence at once, and to be completed on or before the fifteenth day of November, as required by chapter 408, Acts of 1899. You will be provided with a book to carry out the provisions of section 23 and a book to carry out the provisions of section 29.

Cattle are not to be quarantined as tuberculous unless they show enough evidence of disease to make it possible to condemn them on a physical examination, except where the udder of a milch cow is tuberculous. On no account are cattle to be quarantined simply for the purpose of testing them with tuberculin, when they show no physical signs of disease. The only exception to this rule is, that it is the duty of the inspectors of animals to quarantine all cattle brought into the State without a permit from this Board, until the owner furnishes the Cattle Commission with satisfactory certificates of a tuberculin test. Before quarantining any cattle you should decide upon what cows you are going to quarantine, then send the papers on a number at once, so our agent can see them all on one visit.

As section 29 requires that the results of your inspection shall be incorporated in the annual report of this Board, you will see that it is necessary to have your returns by November 15 in order to prepare them for publication. Your books go forward to-day by express.

AUSTIN PETERS, *Chairman*,
L. F. HERRICK, *Secretary*,
C. A. DENNEN,
Massachusetts Cattle Commission.

The results of the labors of the inspectors in quarantining cattle supposed to be infected with contagious disease, and the disposition made of them by the Cattle Commissioners and their agents, are shown in the following table: —

Result of Work done by Inspectors in quarantining Cattle.

CITY OR TOWN.	MASSACHUSETTS CATTLE.								CATTLE FROM OUT OF STATE.				
									CONDEMNED.				
	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	In Quarantine.
Abington,	2	-	2	-	-	-	-	-	-	-	-	-	-
Acton,	23	2	15	-	-	-	-	6	-	-	-	-	-
Adams,	4	1	3	-	-	-	-	-	-	-	-	-	-
Agawam,	2	-	2	-	-	-	-	-	-	-	-	-	-
Alford,	2	2	-	-	-	-	-	-	-	-	-	-	-
Amesbury,	6	-	2	-	-	-	-	1	-	-	-	3	-
Amherst,	8	-	6	-	-	1	1	-	-	-	-	-	-
Andover,	16	3	13	-	-	-	-	-	-	-	-	-	-
Arlington,	4	1	1	-	-	-	-	1	-	-	-	1	-
Ashburnham,	17	6	7	-	1	-	-	3	-	-	-	-	-
Ashby,	17	7	10	-	-	-	-	-	-	-	-	-	-
Ashfield,	3	-	2	-	-	-	-	1	-	-	-	-	-
Ashland,	11	1	6	-	-	-	-	4	-	-	-	-	-
Athol,	18	3	12	-	1	-	-	2	-	-	-	-	-
Auburn,	3	-	3	-	-	-	-	-	-	-	-	-	-
Avon,	1	-	1	-	-	-	-	-	-	-	-	-	-
Ayer,	3	3	-	-	-	-	-	-	-	-	-	-	-
Barnstable,	7	4	3	-	-	-	-	-	-	-	-	-	-

Barre,	77	69	7	–	–	–	–	1	–	–	–	–	–
Becket,	2	–	1	–	–	–	–	1	–	–	–	–	–
Bedford,	7	–	6	–	1	–	–	–	–	–	–	–	–
Belchertown,	13	2	9	–	1	1	–	–	–	–	–	–	–
Bellingham,	10	1	1	–	–	–	–	1	–	–	–	7	–
Bernardston,	2	1	–	–	–	–	–	1	–	–	–	–	–
Billerica,	57	21	34	–	–	–	–	2	–	–	–	–	–
Blackstone,	1	–	–	–	–	1	–	–	–	–	–	–	–
Blandford,	12	6	4	–	1	–	–	1	–	–	–	–	–
Bolton,	31	12	17	–	–	1	1	–	–	–	–	–	–
Boston,	642	5	9	–	–	–	–	–	–	7	–	621	–
Boxborough,	8	1	6	–	–	1	–	–	–	–	–	–	–
Boxford,	2	–	1	–	1	–	–	–	–	–	–	–	–
Braintree,	2	–	–	–	–	–	–	2	–	–	–	–	–
Bridgewater,	2	1	1	–	–	–	–	–	–	–	–	–	–
Brimfield,	2	–	1	–	–	1	–	–	–	–	–	–	–
Brockton,	17	11	5	–	–	–	–	1	–	–	–	–	–
Brookline,	6	6	–	–	–	–	–	–	–	–	–	–	–
Buckland,	7	8	3	–	1	–	–	–	–	–	–	–	–
Burlington,	7	1	5	–	1	–	–	–	–	–	–	–	–
Cambridge,	8	2	–	–	–	–	–	–	–	–	–	1	–
Canton,	1	1	–	–	–	–	–	–	–	–	–	–	–
Carlisle,	24	6	17	–	–	–	–	1	–	–	–	–	–
Charlemont,	8	–	–	–	–	1	–	2	–	–	–	–	–
Charlton,	23	6	12	–	1	–	–	4	–	–	–	–	–
Chelmsford,	7	2	5	–	–	–	–	–	–	–	–	–	–
Cheshire,	1	1	–	–	–	–	–	–	–	–	–	–	–
Chester,	6	1	–	–	–	–	–	–	–	–	–	5	–
Chesterfield,	1	–	1	–	–	–	–	–	–	–	–	–	–
Chicopee,	2	1	1	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

	Massachusetts Cattle.								Cattle from out of State.				
									Condemned.				
City or Town.	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	In Quarantine.
Clarksburg,	1	-	1	-	-	-	-	-	-	-	-	-	-
Colrain,	65	27	12	-	-	1	1	14	-	-	-	5	-
Concord,	38	4	30	-	1	-	-	3	-	-	-	-	-
Conway,	39	11	22	-	1	1	2	2	-	-	-	-	-
Cummington,	4	2	2	-	-	-	-	-	-	-	-	-	-
Dalton,	1	1	-	-	-	-	-	-	-	-	-	-	-
Danvers,	4	-	4	-	-	-	-	-	-	-	-	-	-
Dartmouth,	3	-	3	-	-	-	-	-	-	-	-	-	-
Dedham,	2	1	-	-	1	-	-	-	-	-	-	-	-
Deerfield,	8	4	2	1	-	-	-	1	-	-	-	-	-
Dennis,	1	-	1	-	-	-	-	-	-	-	-	-	-
Douglas,	1	1	-	-	-	-	-	-	-	-	-	-	-
Dover,	3	-	1	-	-	-	-	2	-	-	-	-	-
Dracut,	24	9	12	-	-	-	-	1	2	-	-	-	-
Dudley,	2	-	2	-	-	-	-	-	-	-	-	-	-
Dunstable,	10	2	8	-	-	-	-	-	-	-	-	-	-
Duxbury,	5	2	1	-	-	-	-	2	-	-	-	-	-
East Bridgewater,	3	-	2	1	-	-	-	-	-	-	-	-	-

East Longmeadow,	3	-	3	-	-	-	-	-	-	-	-	-	-
Easthampton,	12	3	9	-	-	-	-	-	-	-	-	-	-
Easton,	21	6	12	-	-	-	-	3	-	-	-	-	-
Egremont,	4	3	-	-	-	-	-	1	-	-	-	-	-
Enfield,	2	1	-	-	-	-	-	1	-	-	-	-	-
Erving,	2	1	1	-	-	-	-	-	-	-	-	-	-
Fall River,	23	-	2	-	-	-	-	-	2	-	-	19	-
Falmouth,	2	-	2	-	-	-	-	-	-	-	-	-	-
Fitchburg,	29	1	18	-	-	-	-	1	-	-	-	9	-
Foxborough,	4	1	2	-	-	-	-	1	-	-	-	-	-
Framingham,	2	-	-	-	-	-	-	2	-	-	-	-	-
Franklin,	12	1	8	-	1	-	-	2	-	-	-	-	-
Freetown,	2	1	1	-	-	-	-	-	-	-	-	-	-
Gardner,	20	3	14	-	-	2	-	1	-	-	-	-	-
Gill,	20	8	11	-	-	-	-	1	-	-	-	-	-
Gloucester,	6	2	2	-	-	-	-	2	-	-	-	-	-
Grafton,	27	4	17	-	-	1	-	5	-	-	-	-	-
Granby,	7	3	4	-	-	-	-	-	-	-	-	-	-
Granville,	6	2	4	-	-	-	-	-	-	-	-	-	-
Great Barrington,	3	3	-	-	-	-	-	-	-	-	-	-	-
Greenfield,	38	12	20	-	-	2	2	2	-	-	-	-	-
Greenwich,	5	3	2	-	-	-	-	-	-	-	-	-	-
Groton,	23	11	4	-	-	-	-	8	-	-	-	-	-
Groveland,	1	-	-	-	-	-	-	1	-	-	-	-	-
Hadley,	10	6	3	-	-	1	-	-	-	-	-	-	-
Halifax,	1	-	1	-	-	-	-	-	-	-	-	-	-
Hamilton,	1	1	-	-	-	-	-	-	-	-	-	-	-
Hampden,	3	2	1	-	-	-	-	-	-	-	-	-	-
Hanover,	1	1	-	-	-	-	-	-	-	-	-	-	-
Hanson,	1	-	1	-	-	-	-	-	-	-	-	-	-

Result of Work done by Inspectors in quarantining Cattle — Continued.

CITY OR TOWN.	Massachusetts Cattle.								Cattle from out of State.				
									Condemned.				
	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	In Quarantine.
Hardwick,	16	2	11	-	1	-	1	-	-	1	-	-	-
Harvard,	10	3	5	-	-	-	-	2	-	-	-	-	-
Hatfield,	12	6	5	-	1	-	-	-	-	-	-	-	-
Haverhill,	29	1	20	-	-	1	-	4	-	-	-	3	-
Heath,	9	3	-	-	-	-	-	-	-	1	-	5	-
Hingham,	6	5	1	-	-	-	-	-	-	-	-	-	-
Holbrook,	1	1	-	-	-	-	-	-	-	-	-	-	-
Holden,	7	5	-	-	-	-	-	2	-	-	-	-	-
Holland,	3	1	1	-	-	-	-	1	-	-	-	-	-
Holliston,	6	1	4	-	-	-	-	1	-	-	-	-	-
Holyoke,	5	4	-	-	-	1	-	-	-	-	-	-	-
Hopkinton,	93	13	60	-	1	-	-	19	-	-	-	-	-
Hubbardston,	108	93	13	-	1	-	-	1	-	-	-	-	-
Hudson,	2	-	-	-	1	-	-	1	-	-	-	-	-
Hyde Park,	1	-	1	-	-	-	-	-	-	-	-	-	-
Ipswich,	7	-	3	-	-	-	-	-	-	1	-	3	-
Kingston,	3	-	1	-	-	-	-	2	-	-	-	-	-
Lakeville,	3	1	2	-	-	-	-	-	-	-	-	-	-

Lancaster,	5	2	2	-	-	-	-	1	-	-	-	-	-
Lawrence,	1	-	1	-	-	-	-	-	-	-	-	-	-
Lee,	2	2	-	-	-	-	-	-	-	-	-	-	-
Leicester,	4	3	-	-	-	-	-	1	-	-	-	-	-
Lenox,	31	29	1	-	-	-	-	1	-	-	-	-	-
Leominster,	22	1	12	-	1	-	-	8	-	-	-	-	-
Leverett,	3	-	3	-	-	-	-	-	-	-	-	-	-
Lexington,	8	-	4	-	-	-	-	-	-	-	-	4	-
Leyden,	8	3	1	-	-	2	-	2	-	-	-	-	-
Lincoln,	3	-	3	-	-	-	-	-	-	-	-	-	-
Littleton,	3	-	3	-	-	-	-	-	-	-	-	-	-
Longmeadow,	21	4	13	-	2	1	-	-	1	-	-	-	-
Lowell,	3	1	-	-	-	-	-	-	-	-	-	1	1
Ludlow,	7	-	4	-	-	-	2	1	-	-	-	-	-
Lunenburg,	26	9	13	-	-	-	-	4	-	-	-	-	-
Lynn,	1	-	1	-	-	-	-	-	-	-	-	-	-
Lynnfield,	1	-	1	-	-	-	-	-	-	-	-	-	-
Mansfield,	3	1	1	-	-	-	1	-	-	-	-	-	-
Marblehead,	5	2	3	-	-	-	-	-	-	-	-	-	-
Marion,	1	-	-	-	-	1	-	-	-	-	-	-	-
Marlborough,	7	1	1	-	-	-	-	5	-	-	-	-	-
Marshfield,	7	3	4	-	-	-	-	-	-	-	-	-	-
Mattapoisett,	1	-	1	-	-	-	-	-	-	-	-	-	-
Medfield,	12	12	-	-	-	-	-	-	-	-	-	-	-
Medway,	5	-	5	-	-	-	-	-	-	-	-	-	-
Mendon,	6	1	2	-	1	-	-	2	-	-	-	-	-
Methuen,	4	-	4	-	-	-	-	-	-	-	-	-	-
Middleborough,	5	1	4	-	-	-	-	-	-	-	-	-	-
Milford,	11	-	10	-	-	1	-	-	-	-	-	-	-
Millbury,	7	3	3	-	-	-	-	1	-	-	-	-	-

Result of Work done by Inspectors in quarantining Cattle — Continued.

City or Town.	Massachusetts Cattle.								Cattle from out of State.				
									Condemned.				
	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	In Quarantine.
Millis,	12	2	10	-	-	-	-	-	-	-	-	-	-
Milton,	7	2	3	-	-	1	-	1	-	-	-	-	-
Monson,	9	5	4	-	-	-	-	-	-	-	-	-	-
Montague,	33	13	13	-	1	6	-	-	-	-	-	-	-
Monterey,	2	1	-	-	1	-	-	-	-	-	-	-	-
Montgomery,	3	1	2	-	-	-	-	-	-	-	-	-	-
Natick,	6	1	2	-	-	-	-	3	-	-	-	-	-
Needham,	2	2	-	-	-	-	-	-	-	-	-	-	-
New Bedford,	4	-	4	-	-	-	-	-	-	-	-	-	-
New Marlborough,	2	1	1	-	-	-	-	-	-	-	-	-	-
New Salem,	3	-	-	-	1	-	-	-	-	-	-	2	-
Newton,	6	-	5	-	-	-	-	1	-	-	-	-	-
Norfolk,	4	-	2	-	-	1	1	-	-	-	-	-	-
North Adams,	1	1	-	-	-	-	-	-	-	-	-	-	-
North Andover,	32	7	16	-	1	1	-	7	-	-	-	-	-
North Attleborough,	5	1	4	-	-	-	-	-	-	-	-	-	-
North Brookfield,	9	2	6	-	-	-	-	1	-	-	-	-	-
North Reading,	7	-	3	-	-	-	-	3	-	1	-	-	-

Northampton,	9	–	5	–	–	2	–	2	–	–	–	–	–
Northborough,	2	1	1	–	–	–	–	–	–	–	–	–	–
Northbridge,	8	3	2	–	–	–	–	3	–	–	–	–	–
Northfield,	6	5	–	–	–	–	–	1	–	–	–	–	–
Norwell,	2	–	–	–	–	–	–	1	–	1	–	–	–
Norwood,	10	–	8	–	1	–	–	1	–	–	–	–	–
Oakham,	1	1	–	–	–	–	–	–	–	–	–	–	–
Orange,	18	3	13	–	–	2	–	–	–	–	–	–	–
Otis,	4	2	1	–	–	1	–	–	–	–	–	–	–
Oxford,	8	–	8	–	–	–	–	–	–	–	–	–	–
Palmer,	8	2	5	–	–	–	–	1	–	–	–	–	–
Paxton,	11	3	5	–	–	–	–	3	–	–	–	–	–
Peabody,	1	–	–	–	–	–	–	–	–	–	1	–	–
Pembroke,	4	1	1	–	–	–	–	1	–	–	–	1	–
Pepperell,	7	1	4	–	–	–	–	1	1	–	–	–	–
Petersham,	1	–	1	–	–	–	–	–	–	–	–	–	–
Phillipston,	5	–	–	–	–	–	–	–	–	–	–	5	–
Pittsfield,	1	1	–	–	–	–	–	–	–	–	–	–	–
Plainfield,	6	5	1	–	–	–	–	–	–	–	–	–	–
Plymouth,	1	–	1	–	–	–	–	–	–	–	–	–	–
Prescott,	3	2	1	–	–	–	–	–	–	–	–	–	–
Princeton,	36	3	26	–	1	–	–	3	–	3	–	–	–
Quincy,	1	1	–	–	–	–	–	–	–	–	–	–	–
Reading,	6	–	5	–	–	–	–	1	–	–	–	–	–
Rehoboth,	6	–	4	–	–	–	–	1	–	–	–	1	–
Richmond,	1	1	–	–	–	–	–	–	–	–	–	–	–
Rockland,	1	–	1	–	–	–	–	–	–	–	–	–	–
Rowe,	39	35	2	–	–	–	–	–	–	–	–	2	–
Royalston,	23	7	12	–	2	1	–	1	–	–	–	–	–
Rutland,	20	3	14	–	1	–	–	2	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Continued.

City or Town.	Massachusetts Cattle. Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Cattle from out of State. Condemned. Sent out of State.	Condemned. Killed, no Award.	Condemned. Killed and paid for.	Released.	In Quarantine.
Salem,	23	10	8	-	1	1	-	-	-	-	-	3	-
Salisbury,	2	-	1	-	-	-	-	-	-	-	-	1	-
Sandisfield,	4	3	1	-	-	-	-	-	-	-	-	-	-
Sandwich,	1	-	1	-	-	-	-	-	-	-	-	-	-
Saugus,	1	-	-	-	1	-	-	-	-	-	-	-	-
Seekonk,	12	-	9	-	-	-	-	1	-	-	-	2	-
Sharon,	2	1	1	-	-	-	-	-	-	-	-	-	-
Shelburne,	15	2	9	-	-	1	1	2	-	-	-	-	-
Sherborn,	8	-	7	-	-	-	-	1	-	-	-	-	-
Shirley,	4	1	3	-	-	-	-	-	-	-	-	-	-
Shrewsbury,	1	-	1	-	-	-	-	-	-	-	-	-	-
Shutesbury,	1	1	-	-	-	-	-	-	-	-	-	-	-
South Hadley,	9	2	7	-	-	-	-	-	-	-	-	-	-
Southampton.	11	2	8	-	-	-	-	1	-	-	-	-	-
Southborough,	5	1	3	-	-	-	-	1	-	-	-	-	-
Southbridge,	1	-	1	-	-	-	-	-	-	-	-	-	-
Spencer,	4	3	1	-	-	-	-	-	-	-	-	-	-
Springfield,	3	2	1	-	-	-	-	-	-	-	-	-	-

Sterling,	50	19	25	–	–	2	1	3	–	–	–	–	–
Stockbridge,	7	5	1	–	–	–	–	1	–	–	–	–	–
Stoneham,	4	–	1	–	–	–	–	1	–	–	–	2	–
Stoughton,	1	–	1	–	–	–	–	–	–	–	–	–	–
Stow,	11	1	4	–	–	–	–	6	–	–	–	–	–
Sudbury,	3	1	1	–	–	–	–	1	–	–	–	–	–
Sunderland,	18	7	10	–	–	–	–	1	–	–	–	–	–
Sutton,	23	6	13	–	1	–	–	2	–	1	–	–	–
Swansea,	3	1	1	–	–	–	–	1	–	–	–	–	–
Taunton,	7	2	3	–	–	–	–	2	–	–	–	–	–
Templeton,	7	2	4	–	–	–	–	1	–	–	–	–	–
Tewksbury,	25	14	9	–	–	–	–	2	–	–	–	–	
Tolland,	2	1	1	–	–	–	–	–	–	–	–	–	–
Topsfield,	5	1	–	–	–	–	–	–	–	2	–	2	–
Townsend,	12	3	7	–	–	–	–	2	–	–	–	–	–
Tyngsborough,	3	1	2	–	–	–	–	–	–	–	–	–	–
Upton,	5	3	2	–	–	–	–	–	–	–	–	–	–
Uxbridge,	5	–	4	–	–	–	–	1	–	–	–	–	–
Wakefield,	44	33	5	–	–	6	–	–	–	–	–	–	–
Walpole,	12	1	8	–	–	–	–	3	–	–	–	–	–
Waltham,	55	51	2	–	–	2	–	–	–	–	–	–	–
Ware,	9	4	5	–	–	–	–	–	–	–	–	–	–
Warren,	1	–	–	–	1	–	–	–	–	–	–	–	–
Watertown,	5	1	–	–	–	–	–	1	–	–	–	3	–
Wayland,	5	2	3	–	–	–	–	–	–	–	–	–	–
Webster,	1	–	–	–	1	–	–	–	–	–	–	–	–
Wellesley,	5	2	3	–	–	–	–	–	–	–	–	–	–
Wendell,	5	1	4	–	–	–	–	–	–	–	–	–	–
Wenham,	1	–	1	–	–	–	–	–	–	–	–	–	–
West Bridgewater,	5	4	1	–	–	–	–	–	–	–	–	–	–

Result of Work done by Inspectors in quarantining Cattle — Concluded.

CITY OR TOWN.	Massachusetts Cattle.								Cattle from out of State.				
									Condemned.				
	Number quarantined.	Number released.	Number condemned, killed and paid for.	Number condemned and killed, no Award, not owned in State Six Months.	Died in Quarantine, no Award.	Permit to kill, no Award.	Permit to kill, paid for.	Condemned, Warrants in Process of Settlement.	Sent out of State.	Killed, no Award.	Killed and paid for.	Released.	In Quarantine.
West Brookfield,	12	2	9	-	1	-	-	-	-	-	-	-	-
West Newbury,	17	8	7	-	1	-	-	1	-	-	-	-	-
West Springfield,	2	-	2	-	-	-	-	-	-	-	-	-	-
West Stockbridge,	1	1	-	-	-	-	-	-	-	-	-	-	-
Westborough,	1	1	-	-	-	-	-	-	-	-	-	-	-
Westfield,	12	7	4	-	-	-	-	1	-	-	-	-	-
Westford,	10	1	5	-	2	-	-	2	-	-	-	-	-
Westhampton,	7	2	4	-	-	-	-	1	-	-	-	-	-
Westminster,	14	5	7	-	1	-	-	1	-	-	-	-	-
Weston,	7	2	5	-	-	-	-	-	-	-	-	-	-
Westport,	3	-	3	-	-	-	-	-	-	-	-	-	-
Westwood,	55	41	6	-	-	8	-	-	-	-	-	-	-
Weymouth,	4	-	1	-	2	-	-	1	-	-	-	-	-
Whately,	6	3	3	-	-	-	-	-	-	-	-	-	-
Wilbraham,	2	1	1	-	-	-	-	-	-	-	-	-	-
Williamsburg,	8	5	1	-	-	1	-	1	-	-	-	-	-
Wilmington,	7	-	5	-	-	-	-	2	-	-	-	-	-
Winchendon,	5	2	3	-	-	-	-	-	-	-	-	-	-

Winchester,	7	5	1	-	-	1	-	-	-	-	-	-	-
Windsor,	5	5	-	-	-	-	-	-	-	-	-	-	-
Woburn,	10	1	8	-	-	-	-	1	-	-	-	-	-
Worcester,	16	1	10	-	-	-	-	5	-	-	-	-	-
Worthington,	6	4	1	-	-	-	-	1	-	-	-	-	-
Wrentham,	16	1	1	-	-	-	-	-	-	-	-	14	-
Totals,	3,249	954	1,178	2	43	64	15	242	6	18	1	725	1

Included in the above there were: —

Quarantined on "voluntary request,"		291
Quarantined and found to have actinomycosis,		4
Quarantined for symptomatic anthrax, and killed,	1	
Quarantined for symptomatic anthrax, and released,	169	
Total,		170
Quarantined at Brighton, condemned and killed,	8	
Quarantined at Brighton, and released,	620	
Total,		628
Quarantined and released after Dec. 1, 1900, for lack of funds,		48

It will be seen by the foregoing table that during the year the local inspectors quarantined for various causes 3,249 cattle; of these, 1,178 have been killed and paid for as tuberculous; 79 were killed on a permit to kill, 15 of which were too badly infected with tuberculosis to prove fit for beef, and were paid for, the owners taking the hides and carcasses of the other 64 to dispose of for their own benefit; there are also 242 cattle, killed as tuberculous, which have not as yet been paid for. This makes a total of 1,435 head of cattle killed during the year as tuberculous quarantined by the local inspectors, nearly all of which were so badly diseased as to be condemned on a physical examination.

In addition to the animals in the above table, 30 head of cattle were reported as having been condemned as unfit for food at the slaughter house because of tuberculosis, or as having been received at the rendering establishments. One swine was also condemned as unfit for food because of tuberculosis.

Very little tuberculin has been used except for testing the animals held in quarantine at Brighton and other points as coming from without the State, and for 291 animals which were tested at the voluntary request of their owners, who wished to eradicate this disease from their herds.

Whether the bovine and human tubercle bacillus is identical, and whether there is any danger to human beings from the use of milk from cows with tuberculosis, or not, may be a question; but it cannot be denied that cows that are badly diseased or that have tuberculosis in their udders give tubercle bacilli in the milk, and it is a known fact that milk from these animals fed uncooked will produce tuberculosis in pigs, calves, rabbits and guinea pigs, if given to them. Even granting that it is not proved that milk from tuberculous cows is any danger to human beings, no sane person would advocate feeding to children material that will infect calves, pigs and other animals.

Most of the animals killed were sufficiently diseased to present very well-marked lesions, and several had tuberculosis of the udder; such creatures are certainly unfit for a public milk supply in a community where milk is usually used un-

cooked, to say nothing of the danger there is of a badly diseased animal infecting other members of the herd.

Beside examining the animals and quarantining diseased ones, the inspectors in their annual inspection have to examine the premises and water supply, and report upon their condition. An idea of the amount of labor involved in this inspection may be obtained from the following table: —

Inspection of Animals, Stables, etc.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
Abington,	130	268	6	-	34	308	-	125	130	2
Acton,	131	1,129	29	2	135	1,295	1	108	131	27
Acushnet,	126	446	14	-	119	579	29	417	126	4
Adams,	74	651	28	-	331	1,010	-	348	74	2
Agawam,	121	1,087	37	5	396	1,525	-	288	121	9
Alford,	51	367	17	-	98	482	176	116	51	3
Amesbury,	130	462	13	10	136	621	-	152	130	5
Amherst,	102	1,178	49	4	344	1,575	65	188	102	13
Andover,	129	1,018	28	6	231	1,283	26	852	129	6
Arlington,	100	252	1	-	12	265	-	1,144	100	5
Ashburnham,	129	397	11	-	241	649	42	180	129	18
Ashfield,	98	747	50	-	587	1,384	1,079	308	98	2
Ashby,	131	502	9	-	73	584	19	94	131	7
Ashland,	88	373	10	-	131	505	6	181	88	5
Athol,	162	479	16	14	213	722	21	204	162	3
Attleborough,	138	760	14	2	95	871	-	280	138	22
Avon,	49	133	2	-	25	160	-	81	49	2
Ayer,	31	84	-	-	13	97	2	9	31	2
Auburn,	74	670	30	-	154	854	5	102	74	1
Barnstable,	222	390	17	15	219	641	27	509	222	2
Barre,	93	1,089	43	13	482	1,627	7	102	93	8
Becket,	117	436	55	44	547	1,082	342	196	117	1

Bedford,	70	436	25	-	210	671	-	402	70	2
Belchertown,	329	2,254	129	20	1,036	3,439	-	679	329	15
Bellingham,	120	542	15	-	144	701	6	115	120	12
Belmont,	51	213	4	-	14	231	-	87	51	2
Berkley,	95	275	11	-	79	365	16	178	95	3
Berlin,	94	491	21	4	153	669	-	71	94	1
Bernardston,	89	542	17	6	325	890	416	290	89	2
Beverly,	14	233	5	3	18	259	-	10	14	3
Billerica,	88	685	22	1	161	869	24	187	88	1
Blackstone,	21	153	6	4	24	187	-	27	21	5
Blandford,	141	842	74	57	675	1,648	382	538	141	1
Bolton,	96	740	23	17	194	974	53	194	96	6
Boston,	15	265	10	-	29	304	-	977	15	2
Bourne,	52	115	7	1	53	176	-	192	52	1
Boxborough,	53	391	36	-	314	741	14	55	53	2
Boylston,	69	614	19	4	158	795	1	116	69	2
Boxford,	90	545	24	8	197	774	24	22	90	2
Braintree,	59	337	7	-	36	380	-	343	59	2
Brewster,	97	123	4	5	64	196	-	91	97	5
Bridgewater,	173	532	15	26	144	717	87	286	173	4
Brimfield,	128	928	47	29	400	1,404	176	210	128	3
Brockton,	113	771	19	2	91	883	-	83	113	3
Brookfield,	153	615	24	14	309	962	-	55	153	9
Brookline,	22	154	4	-	30	188	-	4	22	2
Buckland,	135	741	22	29	326	1,118	454	283	135	-
Burlington,	43	436	5	2	72	515	-	2,103	43	2
Cambridge,	21	123	-	-	-	123	-	-	21	2
Canton,	129	451	14	6	110	581	-	-	129	2
Carlisle,	66	505	14	-	94	613	-	157	66	9
Carver,	71	107	3	1	35	146	19	110	71	2
Charlemont,	93	628	37	2	174	841	430	208	93	1

Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
Charlton,	198	1,179	61	24	709	1,973	13	461	198	–
Chatham,	82	151	6	–	30	187	–	115	82	1
Chelmsford,	46	522	17	–	98	637	–	83	46	4
Chelsea,	26	162	2	–	3	167	–	–	26	10
Cheshire,	95	868	31	–	382	1,281	–	329	95	5
Chester,	174	533	36	40	592	1,201	343	169	174	5
Chesterfield,	103	577	39	40	502	1,158	85	141	103	6
Chicopee,	107	666	21	–	235	922	19	252	107	9
Chilmark,	45	98	8	2	87	195	1,559	56	45	7
Clarksburg,	91	352	11	–	162	525	–	231	91	6
Clinton,	13	35	1	–	9	45	–	4	13	1
Cohasset,	118	260	6	9	58	333	–	67	118	4
Colrain,	185	1,181	61	24	786	2,052	1,293	464	185	7
Concord,	140	1,906	62	–	206	2,174	–	1,999	140	72
Conway,	96	1,030	48	24	722	1,824	571	54	96	7
Cottage City,	35	104	3	–	17	124	43	109	35	2
Cummington,	46	336	15	8	148	507	36	57	46	1
Dalton,	85	496	24	2	138	660	505	119	85	2
Dana,	57	198	12	4	131	345	3	75	57	–
Danvers,	73	828	11	4	22	865	–	121	73	1
Dartmouth,	228	1,507	40	24	260	1,831	21	558	228	4
Dedham,	94	565	11	–	24	600	–	245	94	–

Deerfield,	68	511	12	-	163	696	80	189	68	2
Dennis,	41	77	-	-	11	88	-	32	41	4
Dighton,	110	361	3	4	102	470	-	271	110	8
Douglas,	106	231	10	4	118	363	-	160	106	2
Dover,	83	734	22	-	100	856	3	537	83	2
Dracut,	150	1,190	16	8	64	1,278	-	1,376	150	15
Dudley,	94	773	33	9	187	1,002	36	193	94	8
Dunstable,	69	468	20	-	229	707	12	135	69	3
Duxbury,	124	287	15	3	17	322	20	232	124	3
East Bridgewater,	187	657	14	4	111	786	-	159	187	23
East Longmeadow,	102	471	-	-	350	821	-	132	102	1
Eastham,	65	103	5	1	38	147	-	12	65	2
Easthampton,	137	699	18	5	71	793	-	254	137	6
Easton,	199	663	17	10	154	844	-	97	199	2
Edgartown,	67	243	6	4	80	333	1,009	137	67	2
Egremont,	99	979	40	-	225	1,244	361	119	99	11
Enfield,	79	379	3	16	184	582	21	159	79	1
Erving,	35	138	8	-	70	216	-	78	35	3
Essex,	62	437	13	2	91	543	4	77	62	2
Everett,	25	214	5	-	3	222	-	-	25	3
Fairhaven,	113	393	4	-	72	469	-	138	113	2
Fall River,	187	718	10	3	80	811	47	375	187	6
Falmouth,	164	344	9	2	114	469	17	326	164	3
Fitchburg,	139	706	30	12	210	958	18	255	139	2
Florida,	71	284	44	2	222	552	192	247	71	2
Foxborough,	136	362	11	-	111	484	-	214	136	4
Framingham,	19	372	15	-	56	443	13	44	19	3
Franklin,	150	852	19	2	193	1,066	11	61	150	1
Freetown,	122	216	10	12	108	346	28	167	122	8
Gardner,	43	506	18	2	59	585	20	167	43	9
Gay Head,	23	21	9	18	41	89	11	11	23	2

Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
Georgetown,	86	214	8	8	136	366	41	168	86	1
Gill,	69	632	33	-	275	940	89	325	69	3
Gloucester,	145	674	13	-	139	826	3	300	145	1
Goshen,	48	244	18	6	287	555	55	138	48	-
Gosnold,	12	34	4	-	11	49	2,199	15	12	-
Grafton,	141	1,095	41	6	361	1,503	173	171	141	2
Granby,	125	1,194	31	-	134	1,359	139	168	125	4
Granville,	142	600	46	40	470	1,156	95	11	142	4
Great Barrington,	65	566	29	2	208	805	34	271	65	3
Greenfield,	63	641	16	6	289	952	1,735	322	63	1
Greenwich,	64	313	16	-	122	451	-	85	64	2
Groton,	149	798	45	4	323	1,170	75	210	149	9
Groveland,	69	244	9	8	90	351	13	134	69	3
Hadley,	185	1,019	21	6	128	1,174	42	461	185	7
Halifax,	64	124	4	5	39	172	2	95	64	2
Hamilton,	64	311	13	6	93	423	187	143	64	2
Hampden,	97	512	21	4	275	812	13	146	97	-
Hancock,	57	546	37	2	236	821	1,179	70	57	2
Hanover,	116	240	5	4	56	305	5	172	116	7
Hanson,	92	149	1	-	51	201	10	263	92	2
Hardwick,	130	1,536	87	24	681	2,328	71	135	130	4
Harvard,	174	1,059	40	1	579	1,699	62	148	174	3

Harwich,	144	204	3	5	52	264	5	116	144	2
Hatfield,	136	81	10	19	152	262	-	-	136	4
Haverhill,	197	1,050	28	21	192	1,291	27	406	197	18
Hawley,	86	567	46	22	380	1,015	374	234	86	3
Heath,	83	612	23	4	501	1,140	349	245	83	3
Hingham,	179	622	32	1	146	801	47	130	179	4
Hinsdale,	106	576	27	2	317	922	56	270	106	3
Holden,	186	957	27	-	375	1,339	-	168	186	2
Holbrook,	80	145	3	3	14	165	4	235	80	2
Holland,	36	104	12	2	109	227	60	59	36	2
Holliston,	121	572	22	4	127	725	12	87	121	4
Holyoke,	78	558	14	4	175	751	2	117	78	4
Hopedale,	33	102	2	10	32	146	-	65	33	3
Hopkinton,	128	171	7	-	81	259	-	112	128	4
Hubbardston,	57	550	37	35	197	819	65	79	57	2
Hudson,	34	186	9	-	97	292	-	19	34	2
Hull,	21	55	-	12	-	67	-	19	21	5
Huntington,	106	424	26	12	397	859	198	96	106	2
Hyde Park,	18	121	4	-	2	127	-	13	18	1
Ipswich.	150	684	23	14	191	912	22	372	150	3
Kingston,	85	245	15	6	148	414	-	184	85	2
Lakeville,	97	262	33	6	142	443	16	131	97	12
Lancaster,	96	457	25	-	213	695	-	19	96	6
Lanesborough,	112	860	49	4	383	1,296	-	303	112	2
Lawrence,	11	79	4	-	20	103	-	69	11	-
Lee,	179	611	17	12	353	993	162	230	179	4
Leicester,	8	49	1	-	14	64	-	2	8	1
Lenox,	31	341	21	-	138	500	456	179	31	1
Leominster,	88	370	18	3	187	578	29	58	88	2
Leverett,	97	378	13	10	199	600	66	208	97	2
Lexington,	55	990	21	-	119	1,130	8	295	55	7

Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
Leyden, ...	66	381	14	4	395	794	458	257	66	3
Lincoln, ...	101	818	26	-	194	1,038	13	385	101	2
Littleton, ...	100	1,550	41	-	53	1,644	6	99	100	3
Longmeadow, ...	46	225	11	-	116	352	-	452	46	2
Lowell, ...	58	261	4	2	30	297	2	244	58	2
Ludlow, ...	132	883	23	30	81	1,017	60	195	132	3
Lunenburg, ...	138	857	32	2	277	1,168	4	565	138	2
Lynn, ...	96	337	4	-	57	398	-	53	96	4
Lynnfield, ...	34	307	13	-	48	368	8	56	34	1
Malden, ...	13	105	-	-	2	107	-	1	13	-
Manchester, ...	21	80	1	-	-	81	-	1	21	2
Mansfield, ...	87	197	4	4	87	292	4	64	87	2
Marblehead, ...	47	309	6	-	46	361	2	64	47	11
Marion, ...	32	87	1	-	25	113	4	76	32	2
Marlborough, ...	147	796	24	4	214	1,038	-	569	147	1
Marshfield, ...	141	573	12	-	157	742	8	150	141	8
Mashpee, ...	20	18	-	-	14	32	-	67	20	1
Mattapoisett, ...	65	209	3	-	29	241	-	130	65	-
Maynard, ...	20	179	7	-	8	194	1	13	20	1
Medfield, ...	67	512	16	-	93	621	-	413	67	1
Medford, ...	62	355	5	-	9	369	-	27	62	2
Medway, ...	64	323	14	4	125	466	-	46	64	2

Melrose,	47	204	2	-	5	211	-	8	47	3
Mendon,	98	445	14	8	149	616	-	12	98	4
Merrimac,	64	255	9	9	99	372	-	77	64	2
Methuen,	155	1,136	18	-	205	1,359	-	517	155	6
Middleborough,	166	485	19	21	164	689	10	151	166	4
Middlefield,	47	364	20	4	303	691	312	85	47	-
Middleton,	65	228	8	-	38	274	-	86	65	1
Milford,	148	409	8	-	74	491	-	301	148	6
Millbury,	84	650	24	-	230	904	62	186	84	3
Millis,	65	388	15	-	140	543	-	35	65	4
Milton,	93	740	14	-	19	773	11	55	93	2
Monroe,	25	109	13	4	91	217	51	78	25	3
Monson,	157	1,060	49	42	585	1,736	44	234	157	4
Montague,	135	695	27	4	415	1,141	-	202	135	9
Monterey,	63	396	31	-	282	709	136	197	63	2
Montgomery,	44	311	6	20	102	439	74	60	44	2
Mount Washington,	20	77	5	-	34	116	92	44	20	3
Nahant,	13	36	-	-	1	37	-	-	13	1
Nantucket,	85	396	16	4	229	645	136	27	85	2
Natick,	54	368	11	-	22	401	-	276	54	-
Needham,	36	1,250	29	-	76	1,355	-	-	36	-
New Ashford,	23	136	14	-	96	246	444	57	23	-
New Bedford,	84	538	15	4	70	627	8	168	84	5
New Braintree,*	-	-	-	-	-	-	-	-	-	-
New Marlborough,	133	1,296	66	14	79	1,455	222	242	133	4
New Salem,	114	308	21	8	-	337	17	208	114	3
Newbury,	87	912	40	-	411	1,363	88	140	87	2
Newburyport,	114	371	8	-	126	505	-	365	114	7
Newton,	265	1,206	18	-	39	1,263	-	-	265	4
Norfolk,	69	305	9	6	121	441	-	156	69	2

* No report.

Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
North Adams,	45	587	28	-	120	735	-	223	45	3
North Andover,	72	968	29	10	134	1,141	15	96	72	2
North Attleborough,	109	559	11	-	90	660	-	136	109	19
North Brookfield,	180	900	42	-	649	1,591	37	369	180	12
North Reading,	76	362	5	2	81	450	15	58	76	3
Northampton,	54	561	22	-	228	811	18	127	54	1
Northborough,	97	741	23	2	279	1,045	-	468	97	2
Northbridge,	46	325	13	6	106	450	-	94	46	1
Northfield,	173	745	40	4	357	1,146	201	453	173	15
Norton,	147	315	13	6	112	446	-	248	147	4
Norwell,	110	188	7	4	36	235	59	94	110	2
Norwood,	68	321	12	-	18	351	-	40	68	-
Oakham,	62	538	19	4	207	768	-	77	62	1
Orange,	201	981	34	7	317	1,339	77	370	201	6
Orleans,	79	118	5	-	54	177	-	38	79	1
Otis,	122	352	23	56	324	755	299	198	122	3
Oxford,	120	572	20	2	193	787	-	23	120	8
Palmer,	95	587	27	6	222	842	-	2	95	2
Paxton,	61	397	16	-	210	623	-	58	61	2
Peabody,	56	670	20	-	75	765	-	1,022	56	5
Pelham,	72	183	15	11	70	279	-	83	72	2
Pembroke,	106	134	14	2	73	223	51	153	106	3

Pepperell,	180	669	17	4	236	926	12	290	180	5
Peru,	55	330	30	5	302	667	48	-	55	4
Petersham,	97	458	18	16	331	823	25	222	97	11
Phillipston,	73	336	13	6	203	558	18	134	73	2
Pittsfield,	68	953	34	32	281	1,300	66	187	68	3
Plainfield,	88	522	60	14	487	1,083	537	223	88	5
Plymouth,	115	280	10	2	52	344	-	357	115	2
Plympton,	64	99	2	6	76	183	-	28	64	8
Prescott,	74	330	25	18	277	650	300	52	74	2
Princeton,	87	944	44	10	345	1,343	667	33	87	2
Provincetown,	14	62	2	-	19	83	53	-	14	1
Quincy,	119	642	9	-	33	684	-	87	119	8
Randolph,	83	246	5	-	35	286	-	2,079	83	1
Raynham,	70	314	15	8	89	426	-	152	70	1
Reading,	70	359	9	-	57	425	-	32	70	1
Rehoboth,	245	1,330	38	11	447	1,826	12	462	245	7
Revere,	29	130	3	-	3	136	-	856	29	2
Richmond,	110	400	16	-	216	632	1,186	285	110	2
Rochester,	42	136	5	4	65	210	-	79	42	2
Rockland,*	-	-	-	-	-	-	-	-	-	-
Rockport,	55	207	6	-	28	241	-	40	55	2
Rowe,	74	362	29	12	210	613	154	77	74	2
Rowley,	77	357	17	6	218	598	10	145	77	1
Royalston,	89	459	26	12	224	721	25	90	89	1
Russell,	54	153	6	8	88	255	158	102	54	11
Rutland,	118	849	36	10	411	1,306	25	126	118	6
Salisbury,	91	299	1	18	114	432	32	117	91	4
Salem,	11	216	7	1	5	229	-	61	11	1
Sandisfield,	147	607	50	65	493	1,215	356	211	147	3
Sandwich,	87	170	6	-	49	225	42	70	87	-

* No report.

Inspection of Animals, Stables, etc. — Continued.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report
Saugus,	58	781	12	-	25	818	7	151	58	1
Savoy,	122	526	41	7	297	871	62	132	122	4
Scituate,	141	250	3	4	86	343	1	141	141	5
Seekonk,	139	1,027	40	18	248	1,333	29	922	139	6
Sharon,	70	299	4	-	38	341	5	46	70	5
Sheffield,	197	1,497	94	3	669	2,263	116	268	197	15
Shelburne,	101	902	45	12	1,182	2,141	912	327	101	3
Shutesbury,	53	122	6	10	61	199	27	81	53	-
Sherborn,	96	596	23	4	165	788	6	233	96	3
Shirley,	63	299	22	35	39	395	9	39	63	3
Shrewsbury,	145	1,056	47	2	291	1,396	-	415	145	14
Somerset,	70	455	7	2	96	560	-	173	70	3
Somerville,	67	230	1	-	5	236	2	42	67	27
South Hadley,	137	1,443	53	-	609	2,105	1	422	137	1
Southampton,	147	839	-	-	4	843	-	18	147	4
Southborough,	58	1,039	22	2	197	1,260	16	16	58	3
Southbridge,	79	495	24	27	315	861	44	156	79	2
Southwick,	136	764	37	4	348	1,153	306	394	136	10
Spencer,	126	950	55	44	570	1,619	30	336	126	5
Springfield,	97	330	8	1	67	406	27	690	97	2
Sterling,	148	1,393	39	10	308	1,750	32	189	148	2
Stockbridge,	116	691	31	4	407	1,133	418	425	116	14

Stoneham,	52	240	4	-	23	267	-	69	52	1
Stoughton,	71	304	10	-	66	380	-	87	71	1
Stow,	90	718	37	-	428	1,183	2	77	90	1
Sturbridge,	22	152	7	6	83	248	20	52	22	-
Sudbury,	117	1,113	49	4	300	1,466	-	115	117	1
Sunderland,	78	603	-	-	180	783	31	308	78	3
Sutton,	174	829	47	19	477	1,872	33	237	174	5
Swampscott,	32	136	5	-	27	168	1	32	32	-
Swansea,	145	870	24	2	234	1,130	-	576	145	5
Taunton,	76	749	18	16	135	918	-	525	76	2
Templeton,	67	321	14	12	90	437	20	96	67	2
Tewksbury,	137	646	17	8	171	842	1	621	137	3
Tisbury,	20	60	2	-	5	67	-	75	20	2
Tolland,	50	212	9	28	302	551	48	93	50	2
Topsfield,	54	551	19	8	81	659	-	-	54	1
Townsend,	133	347	14	-	124	485	-	197	133	9
Truro,	68	202	5	-	45	252	-	58	68	5
Tyngsborough,	35	364	9	-	87	460	28	12	35	1
Tyringham,	60	475	26	8	257	766	260	75	60	2
Upton,	108	345	17	10	185	557	6	196	108	3
Uxbridge,	141	568	40	31	243	882	1	45	141	3
Wakefield,	86	398	5	3	25	431	77	-	86	12
Wales,	61	232	16	12	140	400	71	-	61	3
Walpole,	131	296	12	-	90	398	14	461	131	3
Waltham,	31	630	8	19	33	690	-	534	31	-
Ware,	145	714	29	8	383	1,134	-	276	145	5
Wareham,	86	212	7	4	35	258	26	125	86	2
Warren,	141	1,365	47	30	643	2,085	29	287	141	6
Warwick,*	-	-	-	-	-	-	-	-	-	-
Washington,	69	425	53	4	439	921	409	150	69	2

* No report.

Inspection of Animals, Stables, etc. — Concluded.

CITY OR TOWN.	Number of Herds inspected.	Number of Cows inspected.	Number of Bulls inspected.	Number of Oxen inspected.	Number of Young Cattle inspected.	Total Number of Cattle inspected.	Number of Sheep inspected.	Number of Swine inspected.	Number of Stables inspected.	Number of Stables improved since Last Report.
Watertown,	62	392	4	–	11	407	–	185	62	3
Wayland,*	–	–	–	–	–	–	–	–	–	–
Webster,	54	244	8	2	58	312	–	81	54	1
Wellesley,	13	203	7	–	16	226	–	–	13	–
Wellfleet,	43	75	–	–	39	114	–	78	43	2
Wendell,	67	158	10	3	191	362	24	154	67	3
Wrentham,	57	318	5	5	31	359	–	88	57	1
West Boylston,	79	651	15	126	484	1,276	–	230	79	2
West Bridgewater,	50	590	27	5	110	732	–	172	50	6
West Brookfield,	93	942	37	32	657	1,668	33	142	93	7
West Newbury,	106	731	35	6	318	1,090	24	198	106	2
West Springfield,	108	765	19	5	243	1,032	–	378	108	3
West Stockbridge,	126	323	6	–	161	490	379	333	126	2
West Tisbury,	61	156	4	4	56	220	1,378	90	61	3
Westborough,	144	1,495	58	12	687	2,252	–	1,029	144	4
Westfield,	265	1,051	30	3	531	1,615	53	48	265	6
Westford,	252	1,350	43	4	426	1,823	6	233	252	2
Westhampton,	88	447	19	4	226	696	32	115	88	3
Westminster,	96	357	16	–	65	438	4	9	96	2
Weston,	27	247	5	–	13	265	16	17	27	2
Westport,	182	556	9	42	154	761	16	224	182	101
Westwood,	52	519	16	2	57	594	–	56	52	1

Weymouth,	199	539	11	2	117	669	1	350	199	–
Whately,	111	490	20	6	–	516	–	331	111	114
Whitman,	91	326	4	36	307	673	–	116	91	4
Wilbraham,	162	1,077	80	4	648	1,809	33	231	162	2
Williamsburg,	81	477	34	13	271	795	–	100	81	2
Williamstown,	162	1,242	51	4	461	1,758	1,330	310	162	9
Wilmington,	93	280	8	2	–	290	220	114	93	5
Winchendon,	160	478	16	6	123	623	59	355	160	38
Winchester,	32	200	2	–	8	210	–	2	32	3
Windsor,	99	637	60	11	476	1,184	181	162	99	4
Winthrop,	19	51	–	–	1	52	–	–	19	2
Woburn,	117	360	7	–	27	394	6	2,486	117	2
Worcester,	263	1,842	45	2	436	2,325	45	366	263	7
Worthington,	115	699	36	18	498	1,251	150	305	115	12
Wrentham,	191	515	19	4	247	785	1	425	191	11
Yarmouth,	70	126	7	–	50	183	–	11	70	4
Totals,	33,000	181,105	6,912	2,399	64,852	258,268	32,411	74,031	33,020	1,662

* No report.

Summary.

Number of herds inspected,	33,000
Number of cows inspected,	181,105
Number of bulls inspected,	6,912
Number of oxen inspected,	2,399
Number of young cattle inspected,	64,852
Total number of cattle inspected,	258,268
Number of sheep inspected,	32,411
Number of swine inspected,	74,031
Number of stables inspected,	33,020
Number of stables improved since last report,	1,662

No report furnished: New Braintree, Rockland, Warwick and Wayland.

The above summary shows the tremendous amount of work accomplished in the aggregate by the inspectors, and, while the improvements noted are not many, yet there seems to be a continual tendency toward a better condition both in the care of live stock and premises.

Many letters were received from the inspectors after completing their annual inspection, showing that the work is a benefit, although many of them complain that it is very difficult to make a complete inspection in the autumn, when so many of the cattle are at pasture, and they think a more thorough one could be made in the spring, before the animals are turned out. This is undoubtedly true. It would also require more money, as more diseased cattle would be found after being housed all winter than can be detected after the creatures have led an out-door life for several months. This is also an argument for more sunshine, fresh air and outdoor exercise. A spring inspection would require a liberal appropriation, and it would be necessary to have it available early in the legislative session.

When it is considered that the summer of 1900 was very dry and the pastures were consequently poor, it is gratifying to hear that neat stock looked so well. This is no doubt in a measure due to the mild weather in the fall, permitting the cattle to run at pasture until late, and the good pasturage resulting from the autumn rains after the long drought was broken, but the inspectors seem to think it is in part due to the annual inspection leading owners to take better care of

their cattle, and the weeding out of the diseased and unthrifty members of herds.

The following letters from inspectors will give an idea of the benefits derived from this work, and also illustrate the difficulties of a fall inspection: —

NORTH ATTLEBOROUGH, MASS., Nov. 15, 1900.

AUSTIN PETERS, Esq., *Chairman, Cattle Commission.*

MY DEAR SIR: — I send you to-night by express my report of the inspection for this year. I trust it will prove satisfactory. I have been surprised and gratified at the marked improvement seen everywhere in the care and cleanliness of the animals and the apparent absence of anything indicating tuberculosis. I have answered the question, "What improvements," etc., invariably "None," supposing that the improvements related to the barns or sheds in which the animals were housed. With but few exceptions all are sheltered satisfactorily; the supply of water from well, spring, river and the town water works is pure and abundant; the appearance of the cattle indicate that they are well fed and groomed.

For the encouragement of the Cattle Commissioners I would state that very general praise has been expressed by the cattle owners at the marked efficiency displayed in the management of the commission, with the wish that they may be satisfactorily supported by the Legislature this session in their recommendations and appropriations desired for a continuance of the work.

Mr. H. P. Wilmarth has a very large and prolific goat farm in the New Boston district, so called, of this town. On my visit there I found 350 goats, in excellent condition. The farm is well conducted, and the owner states that this industry is steadily growing, and profitable. I have not included this inspection in my report.

Yours respectfully, W. HENRY KLING.

WRENTHAM, MASS., Dec. 3, 1900.

State Cattle Commission.

GENTLEMEN: — Having injured my hand, have had my report copied, and trust it will meet with your approval. I send same by express to-day. I have inspected all of the neat stock in town, with the exception of 8 two-year-old heifers that broke pasture and are running wild. This inspection has been very gratifying; the hard-headed ones, who at first said it would not

amount to anything, and some other things, now say, "There has been good work done." I find a big improvement in the stock, and many farmers are paying more attention to cleanliness and sanitation, the latter as far as they can.

Respectfully, E. M. BRASTOW.

NEWBURYPORT, MASS., Nov. 13, 1900.

Dr. AUSTIN PETERS, *Chairman*, *Cattle Commission.*

DEAR SIR: — I send by American express the result of my general inspection. It has been very difficult to accomplish, as the cattle were out in the pastures, and I had to go early and late to find them, and often twice; however, I have succeeded in making a full canvass of my district. I have never seen the cattle in such good, healthy condition as they are this season. A great improvement has been made, and all parties are anxious to have the commission continue in this good work.

Many barns where small herds are kept I have not mentioned, as they are as perfect as can be for comfort.

Yours respectfully, GEO. M. KNIGHT.

WEBSTER, MASS., Nov. 19, 1900.

Dr. AUSTIN PETERS, *Chairman*, *Cattle Commission.*

DEAR SIR: — I forward you to-day the report of my inspection, and am pleased to be able to inform you that I have not been able to detect a single suspicious case of tuberculosis or any other contagious disease, and have found them all in good condition. I also find that the people are paying more attention to the source of water supply; also to light and ventilation.

I have delayed my inspection on account of the unusually mild weather, the cattle being in fields.

Very respectfully yours, L. H. PAQUIN.

DANA, MASS., Dec. 4, 1900.

Cattle Commission.

GENTLEMEN: — I find cattle in better condition this year than I ever have before.

Respectfully yours, A. W. DOANE.

LUDLOW, MASS., Nov. 15, 1900.

Dr. AUSTIN PETERS, *Chairman*, *Cattle Commission.*

DEAR SIR: — I am sending by express my report of inspection of neat cattle, etc. There were some cattle out at pasture that could not readily be found, which are not included. Most of the

work has been done in the early morning and evening, so as to find the cattle that are at home in the stables.

There is a marked improvement in the condition of cattle and stables. If the conditions were such that the inspection could be made in the winter months, we could do better work, as we could examine all the cattle closely if necessary, and could judge better as to the condition of the stables.

Respectfully submitted, A. L. BENNETT.

WENDELL, MASS., NOV. 16, 1900.

To the Honorable Board of Cattle Commissioners.

GENTLEMEN: — I return in this mail the report of inspections. Found hard work to induce people to bring the stock in from the mountain pastures, and impossible to get near them in the pasture.

Have inspected 299 head of cattle, 149 swine and 24 sheep, against 290 cattle, 121 swine and 14 sheep last year.

Some of the stables where I found tuberculosis have been torn out and rebuilt, others cleansed. Have found it at the slaughter houses to some extent, and have notified you of same in each case.

Trusting I meet your approval, I am, very respectfully,

GEO. A. LEWIS.

NORTHAMPTON, MASS., DEC. 6, 1900.

DR. AUSTIN PETERS.

DEAR SIR: — I send by to-day's mail my report of inspection for the last year. I have reported all places containing over 2 head of cattle and have visited besides 153 places containing 1 and 2 head, kept as family cows, kept generally in horse stable or in small stable by themselves, and have found them in good condition and surroundings generally healthy.

The work of the Cattle Commissioners is appreciated very much by the people in this part of the State.

Yours truly, J. H. ROBERTS.

MIDDLEFIELD, MASS., DEC. 1, 1900.

Board of Cattle Commissioners.

GENTLEMEN: — I have completed the inspection of live stock in town. I find no evidence of tuberculosis or other contagious disease. With the exception of 15 animals in different parts of the town that had injured themselves by eating too many apples, I find animals in an unusually healthy and thrifty condition. The increased value of live stock has a tendency toward the better care and feeding of animals.

Respectfully yours, J. T. BRYAN.

Third.—That portion of the work coming under the third classification is the testing of entire herds at the request of the owners, for the purpose of eradicating tuberculosis from them. This has been necessarily done upon a very limited scale, as the commission felt that most of the money would be required to carry on its regular duties, and that work of this character could not well be undertaken unless there was a surplus from the appropriation that could be devoted to this purpose.

In order to make the expense of herd tests as light as possible for the State, and also to put part of the burden of expense upon the owner, in order to make him understand that it was important for him to properly disinfect his premises and buy only tested cattle to replace those killed, he has been required to sign the following conditions, before the commission would test the herd:—

1900.

I , in asking to have my herd tested at the expense of the State, do hereby agree to the following conditions:—

That all reacting animals shall be killed; those that are so badly diseased that they will not pass as fit for beef the State is to pay full appraised value for, up to a limit of $40, according to law; for animals that react, and are so slightly diseased as to prove fit for beef, I will take what the butcher will allow, and not expect payment from the State.

I furthermore agree to disinfect my buildings in such manner as the Cattle Commission shall prescribe.

I also agree to only buy cattle that have passed the tuberculin test to replace those that are killed.

(Signed) .
Witness, .

Under this arrangement the commission furnishes the veterinarian to do the testing, the tuberculin, and pays for the badly diseased animals, the owner taking what the butcher will allow for those that are so slightly infected as to pass as fit for beef.

No farmer will agree to these conditions unless he is sincere in his purpose to eradicate tuberculosis from his herd, as under them there is no incentive to have his herd tested

for the purpose of selling diseased animals to the State as a matter of speculation.

Under the conditions named, the following herds have been tested: —

Date.	Name.	City or Town.	No. tested.	Released.	Killed and paid for.	Sold for Beef.	No Lesions found.
1900.							
Feb. 7,	F. R., . . .	Milton, . .	2	1	-	-	1
March 9,	M. V. T., . .	Westwood, .	48	36	5	7	-
March 9,	J. S., . . .	Lenox, . .	25	24	1	-	1
April 17,	J. S., . . .	Lenox, . .	5	5	-	-	-
April 10,	H. W. C., . .	Westwood, .	5	5	-	-	-
April 14,	N. M., . .	Hamilton, .	1	1	-	-	-
April 24,	J. B., . . .	Wakefield, .	41	30	5	6	-
May 1,	J. B., . . .	Wakefield, .	3	3	-	-	-
April 24,	A. A. S., . .	Colrain, . .	24	9	13	2	-
June 7,	W. E. C., . .	Brookline, .	6	6	-	-	-
June 7,	E. G., . .	Winchester, .	2	1	-	-	-
June 15,	E. G., . .	Winchester, .	1	1	-	-	-
June 21,	B. L. C., . .	Colrain, . .	7	3	2	2	-
June 28,	B. C. N., . .	Rowe, . .	36	35	1	-	1
July 23,	J. H. G., . .	Worcester, .	1	-	1	-	-
Aug. 23,	Town farm, .	Salem, . .	5	4	-	1	1
Sept. 4,	C. W., . .	Waltham, .	53	51	1	1	-
Sept. 12,	J. C., . . .	Colrain, .	5	-	5	-	-
Dec. 4,	S. E. W., . .	Leicester, .	4	3	Unsettled	-	-
Dec. 10,	J. L., . . .	Groton, .	17	9	Unsettled	-	-
			291	227	34	19	4

In addition to this, several persons have made applications for herd tests; two, however, withdrew theirs when they understood the conditions imposed upon them if the tests were made; the other requests are still upon file in the office of the commission. If funds were available for more work of this kind, it is thought more rapid advances in diminishing bovine tuberculosis could be made, especially if it could be combined with better ventilation, sanitation, and breeding animals with more vigorous and stronger constitutions.

An improvement in the way of testing the cattle brought in from without the State is also highly important, in order

to be certain that only healthy animals are brought in to replace those that are destroyed as tuberculous, or that are disposed of for other purposes.

Glanders.

Glanders and farcy have continued to prevail during the past year to an alarming extent, entailing a serious financial loss upon the horse owners of the Commonwealth, to say nothing of its menace to human life and health. More cases, or suspected cases, of this disease have been reported to the Cattle Commission than in any previous year in its history. In 1899 more cases were reported to the Board than ever before, but in 1900 the number has been far in excess of the preceding year.

While the methods for securing reports of cases and of calling the attention of the commission to suspected cases of this malady have had much to do with securing more information concerning the occurrence of this disorder than was formerly obtained, at the same time it seems to have increased somewhat, — at least, that is the opinion of some of the leading veterinarians and renderers who have been consulted in regard to the matter. Not only is there an increase in the number of cases reported during 1900 over any previous year, but it is reported as occurring in more cities and towns. In 1899 cases were reported from only 101 places, while in 1900 the disease was reported from 128 cities and towns.

The following table gives the distribution and prevalence of this malady in various localities throughout the State: —

City or Town.	Killed.	Released.	City or Town.	Killed.	Released.
Abington, ...	1	–	Barre, ...	1	–
Acton, ...	–	3	Bedford, ...	4	1
Acushnet, ...	1	–	Belmont, ...	4	1
Adams, ...	2	–	Beverly, ...	1	–
Andover, ...	1	–	Billerica, ...	–	1
Arlington, ...	8	2	Blackstone, . . .	1	–
Ashby, ...	2	2	Bolton, ...	1	1
Ashland, ...	–	1	Boston, ...	192	–
Auburn, ...	1	–	Boylston, ...	1	1
Avon, ...	2	–	Brockton, ...	6	2
Barnstable, ...	–	1	Brookline, ...	4	1

City or Town.	Killed.	Released.	City or Town.	Killed.	Released.
Burlington, ...	1	–	Medford, ...	4	2
Cambridge, ...	49	8*	Medway, ...	–	1
Carlisle, ...	–	2	Melrose, ...	2	1
Charlton, ...	1	–	Milford, ...	3	–
Chelsea, ...	24	–	Millbury, ...	2	–
Cheshire, ...	–	1	Milton, ...	1	–
Chicopee, ...	2	1	Natick, ...	2	1
Clinton, ...	7	5	Needham, ...	6	1
Cohasset, ...	2	–	New Bedford, . .	11	1
Concord, ...	1	1	Newburyport, . .	–	1
Danvers, ...	–	1	Newton, ...	12	2
Dartmouth, ...	1	–	North Reading, . .	1	1
Dedham, ...	2	–	Norwell, ...	2	1
Dover, ...	8	1	Norwood, ...	1	–
East Longmeadow, .	1	–	Palmer, ...	1	–
Easton, ...	5	–	Peabody, ...	2	–
Enfield, ...	1	–	Pittsfield, ...	1	2
Erving, ...	1	–	Plymouth, ...	1	–
Everett, ...	19	–	Princeton, ...	–	1
Fall River, ...	37	3	Quincy, ...	5	–
Fitchburg, ...	24	13	Reading, ...	4	1
Foxborough, . . .	1	–	Revere, ...	5	–
Gardner, ...	2	1	Rockland, ...	1	1
Gloucester, ...	1	1	Salem, ...	1	–
Goshen, ...	2	–	Salisbury, ...	–	1
Grafton, ...	2	1	Saugus, ...	1	1
Greenwich, ...	1	–	Somerville, . . .	39	7
Groton, ...	–	1	Springfield, . . .	9	3
Groveland, ...	1	–	Sterling, ...	7	3
Hanover, ...	1	3	Stoneham, ...	7	–
Haverhill, ...	1	–	Swampscott, . . .	1	–
Hingham, ...	3	1	Swansea, ...	3	–
Holden, ...	–	1	Templeton, . . .	–	1
Holliston, ...	1	–	Tisbury, ...	–	1
Hubbardston, . . .	1	–	Wakefield, ...	3	–
Hudson, ...	1	–	Walpole, ...	2	–
Hull, ...	–	1	Waltham, ...	7	5
Hyde Park, ...	1	–	Watertown, . . .	2	1
Ipswich, ...	–	4	Wellesley, ...	4	2
Lawrence, ...	4	1	West Springfield, .	–	1
Lee, ...	–	1	Westborough, . .	–	1
Lunenburg, ...	–	1	Westminster, . . .	2	–
Leicester, ...	3	2	Westport, ...	–	1
Leominster, ...	4	1	Weymouth, . . .	5	–
Lexington, ...	7	3	Whitman, ...	1	–
Lincoln, ...	3	2	Winchester, . . .	2	–
Littleton, ...	1	–	Winthrop, ...	3	–
Longmeadow, . . .	–	1	Woburn, ...	1	–
Lowell, ...	1	2	Worcester, ...	37	13
Lynn, ...	6	3	Wrentham, . . .	2	–
Malden, ...	19	6	Westwood, . . .	4	–
Mansfield, ...	–	1	Unknown, ...	1	–
Marblehead, . . .	1	–			
Marlborough, . . .	–	1	Total, ...	699	150
Medfield, ...	1	–			

* One still in quarantine, undecided.

It will be seen by this table that 699 animals have been destroyed as having glanders or farcy between Dec. 15, 1899, and Dec. 15, 1900. Of these, 697 were horses and 2 were mules. There were 149 animals released from quarantine after careful examination, as free from disease, and 1 is still an undecided case, being under observation at the time of preparing this report.

Three of the horses killed will have to be paid for by the Commonwealth, as being free from a contagious disease. In two of these cases guinea pigs inoculated with some of the nasal discharge developed glanders; the horses were killed, and upon post-mortem examination no lesions of glanders could be found; the owners agreed to a reasonable valuation, and will have to be recompensed. It is impossible to produce glanders in guinea pigs without having the germs of glanders present in the material used; and, as this work was carefully done, it seems certain that the micro-organisms of the disease must have been present, yet no lesions were found in the horses killed. It seems possible, then, that animals may carry the germs of disease for a while before appreciable gross lesions develop, and may be a source of danger to others while apparently in a fair state of health themselves, aside from a nasal catarrh or some similar disturbance, in the same manner that a person apparently free from disease can carry the bacillus of diphtheria in the throat, infecting other persons while apparently in health himself.

It is much better to occasionally kill and pay for such an animal, than it would be to err in the opposite direction, and allow a suspicious case to run at large, spreading the disease wherever it went, because it is not certain that it is infected.

The third horse was owned in Salem. He had a discharge from the left nostril, erosions on the mucous membrane in the nose and a very much enlarged sub-maxillary gland on the left side. Because of these symptoms he was ordered killed by a member of the commission, and an autopsy held, at which a number of veterinary surgeons were present. The animal was found to be suffering from a cancer of the palate, the bones in the roof of the mouth on the near side

being diseased, the five upper back molars loosened, a cancerous growth in the nasal cavity, and the enlarged submaxillary lymphatic gland was due to a secondary cancerous growth, instead of glanders. Such an animal is practically worthless; but, as the owner wanted an exorbitant price, which the commission declined to pay, he has resorted to the courts, where the damages will have to be assessed. The commission does not deny that the horse was free from a contagious disease,—it only refuses to pay more than the animal was worth at the time of slaughter.

Compared with the report of the previous year, there appears to have been a decrease in Worcester and Springfield; there is also less in the Merrimac valley than formerly. There was less in Clinton in 1900 than for two or three years, the disease having practically disappeared among the horses owned by the citizens of the town, the horses killed in Clinton, Sterling and Boylston having been in nearly every case the property of contractors employed upon the metropolitan water works. There were more cases found in Fall River in 1900 than in 1899, but the increase may be partly due to a more efficient inspector having been appointed for 1900 than in the previous year. There has also been quite an outbreak in Fitchburg, 24 horses having been killed there in 1900, against 9 in 1899.

Aside from the increases referred to, the greatest and most alarming has been in Boston and the surrounding towns, Boston acting as a centre of infection, and the sufferers outside being in many cases farmers, milkmen, expressmen and teamsters, whose business requires them to make long daily trips from their homes to the city, their teams often having to draw heavy loads both ways, hard work lowering the horses' condition and making them more susceptible to disease. The nature of the work also leads to an extensive use of the public watering troughs on the road. The loss here falls very heavily, as the men who own these animals are those who can very illy afford to lose their live stock.

The past year was the first during which reports were received from the renderers of the State throughout the entire year; and a portion of the increase in the number of cases reported to the commission must be credited to them,

as undoubtedly quite a number of horses would be killed and rendered that the Cattle Commission would never hear of if it were not for these renderers' reports. Whenever a case is reported by one of the rendering establishments as occurring outside of the city of Boston (in Boston the Board of Health has charge of all matters pertaining to glanders and farcy, it having been placed outside of the jurisdiction of the Cattle Commission in this city), that has not already been called to the attention of the commission, the inspector of animals for the city or town where the case occurs is at once instructed to see that the premises from which the horse came have been properly disinfected, and, if any other horses are stabled there, to see that they are free from contagion. In this way it is believed that much good has been accomplished.

Reports have been made by 9 rendering companies, the total number received being 168, including 439 animals supposed to have been suffering from glanders or farcy; of these, 172 occurred in the city of Boston, leaving 267 which came under the jurisdiction of the Board. Of these 267 cases, 209 were previously reported in other ways, leaving 58 to which official attention would not have been called had it not been for these returns.

A few of these cases, not over half a dozen, may not have been glanders or farcy; on the other hand, occasionally an animal infected with this disease may not have been reported. It is therefore probable that the numbers given may be less rather than more than the cases which actually occurred.

The following table will give an idea of the results of the renderers' reports: —

	Number of Reports.	Number of Cases.	Number in Boston.	Number outside of Boston.	Number of Cases outside of Boston not reported to Cattle Commission except by Renderers.
N. Ward Company, Boston,	51	197	153	44	3
Muller Bros., North Cambridge,	39	103	3	100	19
Butchers Slaughtering and Melting Association, Brighton.	37	76	16	60	18
Guy N. Barnes Rendering Company, Fall River.	12	31	-	31	9
New Bedford Product Company, New Bedford.	7	10	-	10	4
Parmenter & Polsey, Peabody,	4	4	-	4	-
Jos. E. McGovern, Lawrence,	7	5	-	5	-
Lowe Bros., Fitchburg,	4	6	-	6	1
Bartlett & Holmes, Springfield,	7	7	-	7	4
Totals,	168	439	172	267	58

This does not include the reports from Bartlett's rendering works in Worcester, as Mr. Bartlett reports directly to Commissioner Herrick whenever he receives an animal with a contagious disease.

The importance and necessity of doing all that is possible to eradicate glanders from the community has been emphasized more strongly than in any previous year by the loss of human life it has occasioned. Three and possibly four persons have been sacrificed to this malady during the past season.

Two deaths in man occurred in Fitchburg, a father and son both dying from disease contracted by caring for a sick horse. One of the staff of the Sixth Regiment, M. V. M., hired a mare from a Mr. A. of Fitchburg to ride at the annual tour of duty at Framingham in June. Two or three days after returning home she appeared to be ailing, and a few days later a veterinarian was called, who treated her for bronchitis; she died Sunday, July 8. The veterinarian was not satisfied with his diagnosis, made a post-mortem examination of the mare, and reported to the Cattle Commission that he believed she had died of glan-

ders. About the date of the mare's death Mr. A. and his son became ill with a sickness which at first puzzled the physicians; the veterinarian told one of them that he believed the animal died of glanders, and suggested the possibility of the men having contracted the disease. This was found to be the case, Mr. A. dying of glanders two weeks later and the son about ten days after Mr. A. This occurrence was particularly sad, as the boy was an only child, the widow being doubly bereaved by the loss of her husband and son so near together.

The case in the mare was one of those obscure cases where the lesions occurred chiefly in the lungs, and the usual enlarged glands in the sub-maxillary region; nasal discharge and chancres on the septum nasi were wanting. She undoubtedly had lesions of glanders in her lungs when taken to camp, and the change of surroundings and work caused it to develop in an acute pulmonary form soon after the return to Fitchburg. There is ample reason for believing this to be the fact, because two more horses owned by Mr. A. were killed by order of the commission July 23, and another one owned by his estate November 3, there being every reason to believe that some of these animals were diseased prior to the mare being let to go to Framingham. Furthermore, a list was obtained of all the horses ridden by officers of the Sixth Regiment at camp in June, and an agent of the board or the inspector in the towns where they were kept examined them all, some seventeen or eighteen in number, and they were found to be free from disease. Only one was not seen, as it had been sent out of the State, but there is no reason to suspect that it was unhealthy. No trouble has as yet been reported from any of these horses.

In addition to the animals killed, eight others kept in Mr. A.'s stables were quarantined and kept under observation, permission being given to use them, but not to sell them. The eight remaining horses were finally released from quarantine November 26, all having been tested with mallein and failing to react, showing no physical signs of disease at that time, and the stables having been thoroughly disinfected.

The last day of October, E. M., a hostler, employed in a stable in Milford, was admitted to the Framingham hospital as a suspected case of small-pox, he being broken out with an eruptive disease of some kind. He died Wednesday evening, November 14. Wednesday, a few hours before his death, Dr. Shea, one of the physicians of the Boston Board of Health, saw the man and said there were symptoms present that did not coincide with small-pox, and, upon asking the man's occupation, suggested that it might be glanders. After his death guinea pigs were inoculated with material from some of the lesions at the laboratory of the Boston Board of Health, and also by Dr. Langdon Frothingham for the Massachusetts Cattle Commission, and in both instances these little animals developed glanders, — proof positive that the man who died was infected with this disease.

An agent of the Cattle Commission was at once sent to Milford, to investigate matters at the stable where E. M. had been employed. Here it was learned that a horse was killed the previous Tuesday, November 13, which the owner had been treating for pneumonia, but, as it did not seem to be improving, he had it killed and buried. Monday, November 19, the carcass was exhumed and examined, and found to have been a case of glanders and farcy. Two other horses were killed in Milford by order of the commission, one during the summer and the other November 20, because of their having glanders, both of which were formerly kept in this stable. The man who died is thus easily connected with the care of glandered horses.

Another possible case of glanders in man has been reported to the Board as occurring in Chelsea last spring. M. F. was told by a physician that he had glanders; he later became an out-patient at the Massachusetts General Hospital, where it does not appear any definite diagnosis was made; he afterward was under the care of another physician in Chelsea, and died, his death certificate being made out as a case of cancer of the throat. It is not unlikely that occasional cases of glanders may occur in man which are not reported as such, because the disease in humans is so uncommon that it is not recognized by the

physicians, and other diagnoses are made. It has been diagnosed as typhoid fever, pneumonia, pleurisy, pericarditis, inflammatory rheumatism, pyæmia, small-pox, and possibly as cancer of the throat. Considering, therefore, the great prevalence of this disease among horses, it is not unlikely that there may be, once in a great while, a case in man which is never correctly diagnosed.

An instance illustrating the difficulty of eradicating this malady, on account of its slow development in some cases, and the possibility of an animal being a bearer of disease for some time before definite symptoms develop, is demonstrated in a case killed by order of the commission in Ashby last October. This animal was a four-year-old colt, apparently in very good condition, plump and sleek, yet with well-marked symptoms of glanders. This colt was at pasture with a glandered horse in the summer of 1899, killed in July of that year; the colt's owner said that it had a cough when he brought it home the previous autumn, — a slight, dry cough, which disappeared when it commenced to run at the nose, about six weeks before it was killed. It is possible for the colt to have contracted the disease in some other way, but it is not at all improbable that it was infected fifteen months previous to the time of killing, and, being young and vigorous, it held the disease in check for a long time.

As to the spread of the infection, there are various ways in which the disorder is disseminated. The Board is of the opinion, as it has said in previous reports, that public watering troughs are one cause, and that in many instances they are misplaced charities. Blacksmith shops, hitching posts, baiting stables, where a healthy horse may be put in a stall previously occupied by a diseased one, and the actual contact of diseased with healthy horses either at home or on the street, are all factors in the extension of glanders, some of course much more important than others.

In the last annual report a condition of affairs was referred to in Melrose, near the lines of Malden and Saugus, where there are men who buy old horses to kill, the refuse and offal being fed to pigs, and the meat sold either to dog

biscuit manufacturers or fertilizer factories. These men pay a little more for a horse to kill than the renderers will; hence a good many worthless horses are sold to them, and among these animals there are some suffering from glanders. These animals are led out over the highway often by irresponsible persons, who may water them at the public watering troughs on the way out, or even sell a horse with glanders to some other person than the killer, if they can get a dollar or two more by so doing.

No one would believe, who had not been out there, that such a condition of affairs could exist, or such a community be found, within ten or twelve miles of the State House, and it reflects anything but credit upon the city whose board of health allows it to continue. There seems to be no legislation to reach these horse killers. It would be wise to enact a law that all persons engaged in the occupation of killing horses shall have a license from the board of health of the city or town where such business is carried on, that such a license shall not be granted to any person or firm which has not a suitable rendering plant, and wagon for removing dead horses from owner's premises, a penalty to be provided for any person or firm not having such a license, and they should also be required by law to report all cases of contagious disease, among animals received at their establishments, to the Board of Cattle Commissioners.

It might also be well to provide that any person who knowingly buys a horse with glanders or farcy shall be liable to the same penalty as the person who knowingly sells such an animal, as now provided for in the law, — the only exception being that a licensed renderer may purchase such an animal for slaughter, if he wishes.

Whether remunerating owners of glandered horses for animals killed by the State would help to diminish the number of cases or not is an open question. If such a policy were decided upon, it would require an annual appropriation of $50,000 to $60,000 for some time. Certain it is that the present condition of affairs is very serious, and the most stringent measures for its eradication will be none too severe. The Cattle Commission has done all in its power to mitigate

the evil, and it has certainly been able to show the true condition of affairs the last year as it never has before, and hopes that its labors may also have accomplished some good results.

Blackleg, or Symptomatic Anthrax.

During the summer of 1900, a disease resembling blackleg in many ways has caused a number of deaths among young cattle at pasture in some parts of Worcester County. Hubbardston was the town where the disease prevailed most extensively and where the chief losses occurred, but similar outbreaks of a more limited extent occurred in surrounding towns, and also in towns at some distance from Hubbardston. Cases were reported from Barre, Princeton, Templeton, Rutland, Greenwich, Prescott, Grafton and Ashby, and possibly Westminster. In the latter town there was a rumor of trouble, but it was not investigated, as it was over before the Board heard of it. The cattle found dead in Westminster were thought to have been chased to death by dogs, but it is barely possible it may have been the same malady met with in the other towns.

The attention of the Cattle Commission was first called to the presence of the disease by Dr. A. S. Cleaves of Gardner, who telephoned to Boston, July 31, reporting an outbreak of a disorder similar to anthrax or blackleg in the town of Hubbardston. Commissioner Herrick was immediately telephoned at Worcester, and on the same afternoon visited the scene of trouble with Dr. Cleaves and Mr. A. W. Clarke, a veterinary student, who was at his home in Hubbardston for his summer vacation.

The following report from Dr. Cleaves and Mr. Clarke gives a very good history of the Hubbardston outbreak, as well as of one case in Princeton, occurring in a young cow owned by N. B. Reed; the animal was pastured on Little Wachusett Mountain. The description of the symptoms given below and the gross post-mortem appearances are so good that it is not necessary to attempt to detail them further; and the post-mortem conditions found in animals dying in other localities, where autopsies were made, were found to be similar in most cases to those existing among the young cattle in Hubbardston.

John Adams's pasture, lying in the southern part of Hubbardston and adjoining Rutland, owned or rented by C. C. Colby of Hubbardston, containing eleven head of cattle, from one to two years old, owned as follows: —

C. C. Colby, Hubbardston,	5
C. F. Rugg, Hubbardston,	2
—— Adams, Hubbardston,	1
S. M. Stone, Hubbardston,	3
Total,	11

On visiting the pasture, July 22, one of Mr. Rugg's heifers was found dead and in a badly decomposed state; was left lying where she was found. Pasture was next visited July 29, and one of Stone's and two of Colby's were found dead; these were in good condition, their skins were removed and carcasses left lying on top of the ground.

The seven remaining alive were driven to the respective owners' places, except one of Mr. Stone's, which was driven to Mr. Colby's and turned out with his herd of milch cows, some ten in number. Mr. Rugg also turned out his with his herd of milch cows, while Mr. Adams's was kept completely isolated in a small field, and Stone's was partially isolated, being tied several rods from several other young calves in an orchard.

Mr. Colby found the Stone heifer dead in his pasture July 30, and skinned and buried the carcass where it lay, notifying Clarke of Hubbardston next day that his remaining heifers did not appear well. Notice was sent to Boston and Worcester that morning, July 31, and Mr. Herrick held post-mortem on the carcass buried July 30, for purpose of getting pathological specimens, if possible. Carcass was again buried, and directions left for lime to be thoroughly worked into the earth around about the spot of burial and death.

The three heifers left at Colby's had the following temperatures: black two-year-old heifer, in splendid physical condition, 106$\frac{2}{5}$; Jersey, eighteen months, fawn heifer, 102$\frac{2}{5}$; brown yearling, 101$\frac{4}{5}$.

August 1, black heifer,	106$\frac{4}{5}$
August 1, Jersey heifer,	102
August 1, brown heifer,	102
August 2, black heifer,	107$\frac{2}{5}$
August 2, Jersey heifer,	101$\frac{4}{5}$
August 2, brown heifer,	102$\frac{3}{5}$

The two-year-old black heifer was killed on the afternoon of August 2. Temperature immediately before death registered 106$\frac{4}{5}$, having dropped from 107$\frac{3}{5}$ in the morning. Symptoms were distressed breathing, bloodshot eyes, local œdematous swelling in the sub-maxillary space and about the larynx and pharynx, pulse 100, and evidence of much pain in the throat; tongue protruding and black, and an inclination to drink water, but unable to do so. This heifer and the Jersey and brown one had been removed from the main herd into a small enclosure across the road. Post-mortem revealed lesions entirely localized in the larynx, pharynx, roots of tongue and surrounding muscles and tissues, except the blood had a peculiar black appearance, and left a dark cherry stain on the hands; mucous membrane at base of tongue very black, and tremendous amount of œdema, extending clear through to the skin.

The temperatures of the brown and Jersey ran as follows: —

August 3, brown heifer,		103$\frac{3}{5}$
August 3, Jersey heifer,		102
August 4, brown heifer,		104
August 4, Jersey heifer,		104$\frac{4}{5}$
August 5, brown heifer,	(A.M.)	107$\frac{4}{5}$
	(P.M.)	108$\frac{3}{5}$
August 5, Jersey heifer,		101$\frac{3}{5}$

In the afternoon of August 5 the brown heifer commenced breathing in a labored sort of way, pulse very weak, eyes bloodshot, and blood commenced oozing out around the ears, neck and both shoulders. She died some time before 6 A.M. August 6, and the post-mortem revealed hemorrhagic spots entirely dotting the folds of serous membranes in both the abdominal and pleural cavities, about the size of twenty-five and fifty cent pieces; no lesions in the throat visible.

A record was made of the temperature of the four remaining heifers until August 29, as follows: —

	Colby's Jersey.	Rugg's Jersey.	Adams's Black and White.	Stone's Brown.
August 7, ...	101	–	102 1/5	102 1/5
August 8, ...	101	102 2/5	102 3/5	101 3/5
August 9, ...	102 3/5	102	101 4/5	102 3/5
August 10, ...	102	102 2/5	102 3/5	103
August 12, ...	101 2/5	102 3/5	101 3/5	101
August 14, ...	100 4/5	102 3/5	101 4/5	100 2/5
August 16, ...	101 1/5	102 3/5	102	102 1/5
August 19, ...	100 3/5	102	101 1/5	101 1/5
August 20, ...	100 2/5	104 1/5	101 1/5	101 1/5
August 21, ...	101	102	101 3/5	101 1/5
August 23, ...	100 4/5	101 4/5	101 2/5	101 3/5
August 25, ...	101 3/5	102	101 3/5	101
August 27, ...	101 1/5	102	102	102
August 29, ...	100 3/5	–	101 4/5	101 4/5

Mr. Rugg's heifer, August 20, developed quick respiration, bloodshot eyes, quick pulse, vomited in the morning of August 20, and commenced to improve until she was evidently normal.

In the Bennett pasture, located in the north-west part of Hubbardston, near the Templeton line, containing thirty-eight head of young cattle, July 28, a bull two years old was found dead. He was partially buried where he died; he belonged to Blanche Bennett of Hubbardston. August 2, L. S. Moore found one of his two-year-old heifers dead; she was also partially buried up. August 6, an eighteen-months-old heifer, belonging to L. S. Moore, was found dead. When the pasture was visited the previous day the three men there were unable to catch this heifer, though they were sure she had a clearly developed enlargement about the lower jaws. Ante-mortem showed œdematous condition about the larynx and pharynx and sub-maxillary space; heifer was found lying in the ferns, and no evidence whatever of any struggling before death. Post-mortem revealed lesions entirely localized in the region of the larynx, pharynx and sub-maxillary muscles, apparently identical with the black Colby heifer. August 9, Frank Hayes found one of his eighteen-months-old heifers dead in this same pasture. All of these carcasses were finally thoroughly burned in this and all the other pastures.

August 8, in the John H. Lackey pasture, located in the south part of the town, and about two miles from the Adams pasture, John Collar found one of his two-year-old heifers dead. This pasture contained three head.

D. P. Ford, living in the western part of the town, having three

heifers and one cow, found one of his yearlings dead, August 4, apparently all right the day before. August 12, a two-year-old was taken sick and was left in the barn; had profuse bloody diarrhœa, œdema of throat and right side; temperature $105\frac{4}{5}$. Died some time during the night, and was dragged across the yard to the road, along this some two hundred yards, then down into the woods, where both carcasses were eventually burned.

Mr. Prentiss, Hubbardston, in charge of a pasture in the eastern part of the town, containing twenty-six head, young and old, belonging to Mr. L. W. Newton, Southborough, found one of the two-year-olds dead August 16 and one eighteen months old August 17. Both carcasses were burned. Another three-year-old, ear tag No. 213, seemed to wish to isolate herself from the others, and no inclination to eat; temperature 104, pulse 90. August 18, she resumed eating, and temperature was normal.

August 27, heifer No. 70 was found dead. A three-year-old was isolating herself from the others, ears lopped, eyes dull and sunken, pulse 95 and temperature 106; August 28, temperature $104\frac{3}{5}$, same physical symptoms; August 29, temperature 104, same physical symptoms, with the addition of bleeding at the nose; in the afternoon, temperature $105\frac{2}{5}$. Killed for post-mortem and pathological specimens. Lesions were found in the pharynx, and in both the serous and mucous membranes in the abdominal cavity. The lesion in the pharynx immediately about the glottis consisted of almost total destruction of the mucous membrane, and œdema extending into the surrounding muscles, slightly discolored at the base of the tongue. All the serous membranes were affected with hemorrhagic spots about the size of quarters and fifty-cent pieces, while on the mucous surfaces immediately in opposition were spots much resembling small ulcers leading one to suggest that the lesion originally started from this surface. These carcasses were all disposed of by burning.

D. V. Meaney, living in Williamsville, directly west of Hubbardston, on August 17 noticed, in a pasture containing ten head of young cattle, that one of his two-year-olds was ill, evinced labored breathing, eyes dull, weak pulse, bloody discharge from rectum and temperature $105\frac{4}{5}$; died some time during the night. Post-mortem held in the afternoon of August 18, and lesions localized in the throat; mucous membrane was dark in color at base of tongue and in pharynx slight œdema; carcass was burned. Mr. Meaney found a yearling dead some ten days before this.

Mr. N. B. Reed, Princeton, had four heifers turned out in a pasture in the north part of the town. August 13 he noticed that

a four-year-old Devon was not feeling well; she was taken to his barn in the village and placed in the cellar; she would try to eat and drink, but seemed unable to do so. August 16, temperature 104⅗, pulse 98, eyes bloodshot, respiration 7, comatose in character; swelling in throat and evidence of pain; drooling profusely from mouth; inclined to lie down a good deal. August 18, symptoms much the same, except respiration was quite rapid, temperature 105 and pulse 100; killed for autopsy. Post-mortem showed lesions entirely localized in the pharynx and immediate surroundings. The mucous membrane was entirely broken down and quite black, considerable œdema of the pharyngeal muscles and ligaments.

September 5, Mr. Morgan, living in the east part of Hubbardston, noticed one of his two-year-old Jersey heifers with profuse diarrhœa. September 6, she would not eat, seemed very dull and inclined to lie down; died that same evening. Post-mortem revealed hemorrhagic spots on the serous surface in the abdominal cavity and black discoloration at base of tongue; bloody fæces in rectum and floating color. This heifer was in milk and running with four others, all but one being milch cows, and the exception was a heifer about thirty months old, in milk. Carcass was burned.

Summary.

Pastures owned by—	Number of Head.	Died.
Mr. Adams,	11	7
Mr. Bennett,	38	4
Mr. Lackey,	3	1
Mr. Ford,	4	2
Mr. Newton,	26	4
Mr. Meaney,	10	2
Mr. Morgan,	5	1
Mr. Reed,	4	1
Totals,	101	22*

* Percentage, 21.78.

Respectfully submitted,

A. S. Cleaves.
A. W. Clark.

There was a report circulating in the town that this was not the first or largest outbreak of this sort in the town, but upon investigation it was found that the only recent deaths in pastures were in 1897. In the Wm. Hartwell pasture, located in the southern part of the town, about two miles from the Adams pasture, H. Clarke found four of his yearlings dead, and Edgar Tilton found three of his dead in a pasture about two miles from these other two pastures.

A. S. CLEAVES.

As already stated above, Mr. Herrick visited the John Adams pasture with Dr. Cleaves and Mr. Clarke, July 31.

August 4, Dr. Peters, Mr. Herrick, Dr. Cleaves, Mr. Clarke and Mr. J. H. Burtch, inspector of animals of Hubbardston, visited the Adams pasture and the surviving animals that had been removed from it, and also the Bennett pasture.

August 18, Dr. Theobald Smith accompanied Dr. Peters, Mr. Herrick and Dr. Cleaves to Hubbardston. On the way from Gardner to Hubbardston a Mr. Le Claire of Templeton informed the party that he had just found two yearlings dead in his pasture. Time did not permit of a visit to his premises, but from his description the heifers died from a similar malady to that occurring in Hubbardston. Upon arriving in Hubbardston, the pasture of David Meaney was first visited, and an autopsy made upon a heifer that died the night before; but decomposition had been so rapid that no specimens were taken, as they were valueless for scientific investigation. The Newton pasture was next visited, but no new cases were found there on this date. From the Newton pasture the party drove to Princeton and went to Mr. N. B. Reed's, where the four-year-old Devon cow, mentioned in Dr. Cleaves' report, was in quarantine. The animal was killed, and specimens taken from the local lesion in the throat and various viscera for examination by Dr. Smith.

August 29, Dr. Langdon Frothingham visited the Newton pasture with Dr. Cleaves, when a three-year-old heifer which was sick was killed for autopsy and specimens taken for scientific study. September 6, autopsy on Morgan heifer was made by Dr. Cleaves, Mr. Herrick being with him.

From the report made by Dr. Cleaves and Mr. Clarke, it would appear that some animals were affected with the disease in a light form, and after being slightly sick for a few days recovered; others seemed to have enjoyed an immunity from it; and about twenty per cent. suffered from a severe form, which was rapidly fatal, an animal that was ailing one day frequently being found dead the day following.

After September 10 the disease subsided, and, as no new cases were reported, the quarantines on the infected pastures were raised September 17 by advice of Mr. Herrick (who went to Hubbardston September 14), except on Paul B. Morgan's pasture, which was removed October 2.

August 6, a yearling heifer was quarantined by Perley Goddard, the inspector in Grafton, owned by Albert Bradish, as having anthrax. A pòst-mortem examination, made August 7 by Mr. Herrick and Dr. C. H. Perry, revealed a similar condition to that found in the Hubbardston cattle. Portions of lung, kidney, spleen, stomach, intestine and tongue were sent to the Harvard Medical School, and examined by Dr. John N. Coolidge, who found a micro-organism of the same character as that found in specimens taken from the Hubbardston cattle, which will be described later. Another yearling owned by Mr. Bradish was found dead in the pasture a few days before Mr. Herrick's visit, and was buried. A cow kept with them remained healthy. This is the only outbreak reported in Grafton.

August 18, Dr. Chas. Paquin, the inspector in Barre, quarantined the cattle in two pastures because of the appearance of a disease similar to that occurring in the adjoining town of Hubbardston. One contained fifty-six head of young cattle, the other fifteen head; several died in each pasture. No new cases occurred in these pastures after September 20; the quarantines were therefore removed October 1.

September 6, a letter and quarantine dated September 3 was received from W. H. Glazier, the inspector of Greenwich, the animal quarantined being a small gray yearling heifer owned by Fred L. Edson. Dr. Cleaves was at once sent to investigate the case. He went to Greenwich September 7, and reports as follows: —

WEST GARDNER, MASS., Sept. 8, 1900.

Dr. AUSTIN PETERS.

DEAR DOCTOR:—The heifer in quarantine died September 6, the day before I arrived in Greenwich, and was buried when I got there. Mr. Edson was away, but the hired man gave me a very intelligent history of the outbreak. It seems that Mr. Edson and Gray of Greenwich hired a pasture in Prescott of Mr. Chas. Abbott, and turned in fourteen head. Edson owned seven, Gray five, Ezra Alden and Chas. Manley, both of Greenwich, each owned one. Four weeks ago they found three heifers dead in the pasture, one each of Edson's, Alden's and Manley's. They had evidently been dead several days; "they were buried about three feet deep, at great trouble to the diggers."

Mr. Gray immediately drove his five head into a pasture adjoining the Abbott pasture, where they have since remained perfectly well, apparently. Mr. Edson drove his home, and turned them with his milch cows in a hill-side pasture near his house, excepting one which he left at Mr. Felton's to have pastured. About August 3 or 4 one of the heifers, about fifteen months old, refused to eat. She grew very emaciated, bled at the nose, had bloody diarrhœa the day before she died, which was August 18; would seem to try to eat for a while, but could not; also drink. Buried her in a sand bank.

The quarantined heifer was about a year old, and they first noticed her August 30, when she would not eat; a considerable amount of swelling around her throat, gritting of the teeth, evidence of some pain, and the day of death bloody diarrhœa and blood exuding through the skin around the head and shoulders. She died September 6, and was buried in a sand bank.

Mr. Glazier had gone to Springfield, but I waited to see him, and advised him to quarantine the Edson farm and any others if they should show evidence of an outbreak. I also told the Edson's to use lime by working it into the earth all about the graves of each animal, and Mr. Glazier said he would see that it was done. The pasture being in Prescott, I suppose you will have to communicate with the inspector there. It certainly appears to be the same thing that is occurring in Hubbardston.

Yours truly, A. S. CLEAVES.

Upon receiving this report, Mr. Henry N. Grover, inspector of animals for Prescott, was written to, telling him to quarantine the pastures where the disease occurred.

September 14 he quarantined two pastures owned by Charles J. Abbott. No new cases being reported from these pastures, the quarantines were ordered removed October 11.

There was an outbreak of blackleg in one pasture in Ashby, probably of a similar character to those appearing in other places; the following correspondence will give a sufficient history of it: —

ASHBY, MASS., Aug. 14, 1900.

DR. PETERS.

DEAR SIR: — I was called this morning to make an autopsy on a heifer that was found dead in the pasture. On making inquiries, I find that this is the third one within the same number of weeks. The heifer was very badly decomposed, but I made the autopsy as best I could, and found it was blackleg or symptomatic anthrax. I did not know before that the commission had anything to do with that disease, but read in your report that you came up here two years ago to see some cattle belonging to a John Wright in Ashburnham. I thought I would let you know, and you can do as you like about it. I examined the rest of the cattle in the pasture, of which there were thirty-three, and found them all right; part of them are young stock. As the carcass was in such a condition, I had it burned.

I have forgotten to say that these cattle are in the pasture belonging to Mr. Woodard of Ashby.

Yours in haste, C. B. SHAW.

Dr. H. D. Clark of Fitchburg was telephoned to investigate this trouble, and Dr. Shaw was written to that this had been done. The following letters are reports of Dr. Clark's visits: —

FITCHBURG, MASS., Aug. 16, 1900.

DR. AUSTIN PETERS.

DEAR SIR: — I went to Ashby yesterday, and saw Dr. Shaw. Dr. Shaw told me there were no new cases of sickness or death among Mrs. Woodard's cattle, and that all those that had died had been buried or burned. The only one Dr. Shaw saw had been dead three days, so he could not make much of an examination.

I drove over to Mrs. Woodard's pasture this afternoon, and saw the cattle, thirty-two of them, and all well. The cattle are to be seen every day, and if there is further trouble Dr. Shaw will be

notified; and I suggested that he telephone me, and together we would make as careful an examination as we could, and send a specimen to you.

Yours truly, H. D. CLARK.

FITCHBURG, MASS., Sept. 1, 1900.

Dr. AUSTIN PETERS.

DEAR SIR: — Dr. Shaw of Ashby telephoned me this morning that another heifer had died in Mrs. Woodard's pasture. I went up there, hoping to make a good examination of the carcass and get a specimen to send you, but found the heifer had been dead several days, and was so badly decayed that I could not make a satisfactory examination. I noticed the skin was wrinkled and cracked open just back of right fore leg and on inside of left thigh; the right leg and thigh had a bloated appearance. I opened the abdominal cavity, but found the maggots working there in such enormous numbers that I could not make much of an examination. There was a spot on right side of the body, about fifteen by six inches, where the hair was all gone and the skin seemed dry and hard, while the skin as well as the muscles on other parts of the body was very soft. The neck was nearly half eaten off by maggots a few inches back of head.

There was one heifer that Mrs. Woodard thought did not act quite natural (the animal had a scaly skin eruption), and I had the animal with a few others shut off in a small part of the pasture, where she can be better watched.

Yours truly, H. D. CLARK.

The disease seems to have disappeared here during September, as it did in the other towns. A few cases were said to have occurred in Rutland, but these were not officially reported to the Board. Mr. Herrick was informed that there is a large pasture in the western part of Princeton where young cattle are said to die every year, and that trouble has existed there for many years, perhaps as many as thirty or forty. It is said that a few young cattle died in this pasture early in the summer of 1900, but these cases were not reported to the commission, and there was no opportunity for an investigation.

Reports were received from more distant parts of the State of deaths among young cattle in Chester and Monroe, and agents of the commission were sent to investigate

them. The results of the investigations do not show the trouble to have been blackleg; but, in view of the cases elsewhere, it is not impossible that this disease was present in these pastures, and that it had subsided when the agents made their visits.

The following correspondence is sufficiently explanatory: —

AUG. 13, 1900.

Cattle Commissioners, Boston, Mass.

DEAR SIRS: — As I have been losing cattle for two weeks past, five in all dying, I reported it to the cattle inspector of Becket, Mass., as that is the town that I live in, but I got no satisfaction from him, as he did not come to see them. It is reported around here that it is a contagious disease that is causing them to drop off. The last two died last Friday and were buried Saturday. My next neighbor lost three in the same manner.

I live between Middlefield and Chester. Trusting that you will give this your attention, and oblige me greatly.

Yours very truly, A. T. BOYD.

PITTSFIELD, MASS., Aug. 17, 1900.

DEAR DR. PETERS: — In accordance with your instructions, I went to Chester to-day and investigated the trouble among the cattle on the pasture of Archibald T. Boyd, and have to report as follows: —

Five weeks ago there were in Boyd's pasture seventeen animals; of these, eleven two-year-old heifers and steers were the property of Boyd, while six animals (a mature bull and five two-year-old creatures) were owned by Mr. Farnham, the neighbor mentioned in Boyd's letter. Five weeks ago one of Boyd's young cattle was found dead in the pasture, and, as there had been a thunder storm the day before, the cause of death was supposed to have been lightning stroke. No more animals died until the latter part of July and the first ten days in this month, during which time four more of the young stock of Boyd and the bull belonging to Farnham died, the last death having occurred Friday, August 10. On August 6, Mr. Farnham removed his five young cattle from the Boyd pasture and turned them into a lot further up the road. These animals were not seen until the following Sunday, August 12, when it was found that three were alive and two were dead. The condition of the carcasses when found led the owner to think that the animals probably died within one or two days from the time they

were removed from the Boyd pasture and put into the new one; further, Boyd thinks they were sick before they were taken from his pasture.

August 10 all the remaining cattle were taken out of the Boyd pasture, since when there have been no more deaths, and all the animals are noticeably improving.

As to the pasture, the land where the seventeen animals had been summering comprises about twenty-four acres, and is of oblong shape, about two-thirds of it open and comparatively level, while one-third is partly wooded and partly brush, sloping down into a lake. The whole is extremely rough and barren. Of the actual surface of the open land, at least one-third is rock and stone, and as I saw it to-day, after having been vacated of stock for a week and after our recent rains, there is positively hardly a spear of grass that an animal could pull, excepting in a few hollow places where there is rank vegetation which the cattle seem to have entirely refused. The wooded and scrub part bordering the lake bears a few tall trees of maple, hemlock and black pine, with a very dense undergrowth of alders, wild rhododendron and laurel, and more especially the latter. Of distinctly poisonous vegetables or trees I did not recognize any.

The last of the dead animals having been buried for over a week, and being described as having been in a bad state of decomposition before burial, I did not think a post-mortem examination under the circumstances would be of any value, and consequently I did not exhume any of them.

As to the nature and cause of the trouble, I am of the opinion that it is all a question of insufficient pasture. The land has never been under cultivation, and the vegetation, in addition to being wild, would at the best be very scanty. Considering the nature of the land, it was overstocked, and this is more especially true when we consider the prolonged period of extremely hot and dry weather which we had until ten days ago. The result was that two-thirds of the available surface was absolutely devoid of anything the animals could eat. The only thing left for them was the coarse, indigestible brush around the margin of the lake, and this, in my opinion, acted as an irritant, causing inflammation of the stomach and resulting in death. The symptoms described would bear out this idea, the animals being noticed dull and walking with a staggering gait one day, and found dead soon after, usually within a day. I would say that towards the north end of the lake was the part where nearly all the dead animals were found, and, judging from the way the ground was tramped and

from the amount of droppings, it must have been the rendezvous of the herd. It was also the part where the rhododendron and laurel were most plentiful, the latter making a dense, continuous brush.

I anticipate that, with change to fresh pastures and with accession of cooler weather and rains, there will not be any more trouble with the herd.

Very truly, GEORGE N. KINNELL.

MONROE BRIDGE, Sept. 22, 1900.

Cattle Commissioners.

DEAR SIRS: — I have just returned from inspecting a dead yearling heifer of Geo. Brown's. H. C. Shippee has had two die, which I did not see, as I did not know of it for several days; but Mr. Brown found his last night, and notified me. Upon opening it, I found the throat near the windpipe black and putrid; the heart black, with no blood in it, — a little nasty water; the lungs of an ink color, a thin fluid flowing from them when cut into; the paunch discharging quite a quantity of very offensive watery matter. I think the case requires an investigation by some one of more experience. If one of your board will come, will meet you at Monroe Bridge, upon notice when you will be there.

Very truly yours, D. H. SHERMAN, *Inspector*.

GREENFIELD, MASS., Oct. 3, 1900.

Dr. AUSTIN PETERS, *Boston, Mass.*

DEAR SIR: — I wrote D. H. Sherman, inspector, Monroe Bridge, and made a date to meet him, but, owing to its being so very mountainous, I did not reach Monroe Bridge on time, and he had gone. I then drove to Geo. Brown's place. Mr. Sherman had been there that day. There has not been any more deaths. Mr. Brown's yearling is the only death in this town of Monroe. Mr. Shippee, who lost two animals, lives in Vermont, so I did not visit him.

The post-mortem that Mr. Sherman held on Mr. Brown's yearling was not for twenty-four hours or more after it died, and, as these deaths were over ten days ago, I think probably the Brown cow did not die of a contagious disease.

Yours truly, M. L. MINER.

The inspector of Salem reported some deaths among cows pastured near a tannery, but, as the animals had been removed and rendered before he reported to the commis-

sion, it is not known whether these animals died from being poisoned by some chemicals used in the process of tanning, or from an infectious disease introduced in the hides. His report is herewith given: —

SALEM, MASS., Aug. 8, 1900.

DEAR DOCTOR: — I have made post-mortem examination upon four cows that have died suddenly in pastures of Salem, and found the same condition in all four, namely extensive gastro-enteritis, also discovered tuberculosis of the lung in one. I understand there have been in all thirteen die that have been in this pasture; the board of health are investigating. There is drainage from a tannery that runs through this field. Please advise me.

Yours truly, F. SAUNDERS.

The first cattle to die in Hubbardston were left to decay on the ground, after being skinned; later, those that died were buried, until the commission took charge; after this, all animals that died were ordered to be cremated wherever it was practicable, and the ground where they lay was burned over. This may have helped to limit the disease; whether it did or not the percentage of mortality in the Adams pasture, where the first case reported occurred, was much greater than it was later, when all the carcasses were either buried with quicklime or burned.

This concludes the history of these outbreaks, so far as a study in the field is concerned. The results of the laboratory work undertaken for the Board of Cattle Commissioners will next be considered.

July 31, Mr. Herrick and Dr. Cleaves made an autopsy on a heifer that died in the Adams pasture during the night of Sunday, July 29. She was very much decomposed, but specimens were taken from the lungs, liver, spleen, third stomach and mesenteric lymphatic glands, which were sent to the Harvard Medical School, where they were examined by Dr. J. N. Coolidge. These arrived in very much decomposed condition. August 2, upon examination, Dr. Coolidge found a bacillus which resembled the bacillus of anthrax; in addition, there were many putrefactive bacteria of various kinds. Further study by means of cultures and inoculation experiments on guinea pigs showed that it was not the bacillus of anthrax, but a bacillus resembling the

bacillus of malignant œdema, and also resembling the bacillus of blackleg. Extracts from Dr. J. N. Coolidge's report follow: —

August 3, specimens received from a two-year-old heifer kept in the same pasture, from lungs, liver, posterior pharyngeal, mediastinal and mesenteric lymphatic glands, tongue, larynx and pharynx, showed the same bacillus as in the specimens received August 2. Further investigation showed this to be an anaerobic bacillus. Inoculated guinea pigs died in less than forty-eight hours, and showed much œdema.

The bacilli were not found in the guinea pig's blood before death. There were no microscopic changes in their organs. Bacilli were found in small numbers in their blood after death, and in the spleen. They were spore-producing; sometimes were in filaments, and in rather long, narrow chains. They decolorized by Gram's method. They grew in anaerobic conditions [*i.e.*, they grew when cultivated in the absence of oxygen]. Smears from the peritoneum showed filamentous forms.

August 7, specimens received from Mr. Colby. The results were the same; the organs sent were the same.

August 8, specimens from Grafton; same organs, same results.

August 30, material brought by Dr. Langdon Frothingham from Hubbardston. Very little found in smears. Inoculation experiments not conclusive. Guinea pigs died in five days; rabbits not affected. I have not tried to draw conclusions.

The material taken August 18 from the four-year-old Devon cow, owned by N. B. Reed of Princeton, included specimens from the throat, lungs, spleen and liver. The lungs contained a few small foci of pneumonia, which may have been mechanical, as the result of taking minute particles of food into them, due to an inability to swallow properly on account of the throat lesions. Dr. Smith, however, was able to isolate from the throat lesions, liver and spleen an anaerobic spore-bearing bacillus, similar to the one described by Dr. Coolidge. A streptococcus and other bacteria were found which were not studied further. Inoculation tests upon guinea pigs proved equally fatal; it also killed mice.

A healthy two-year-old heifer, brought down from Pepperell by Commissioner Dennen, was inoculated August 24

with a culture made from the liver of the Princeton cow, in bouillon, August 21. Four cubic centimeters of this culture were injected into the subcutaneous connective tissue on the right shoulder. In twenty-four hours there was a swelling at the seat of inoculation the size of half a hen's egg, which was hard and very painful on pressure. The heifer's temperature arose to 103° F., where it remained four or five days, when it gradually subsided to normal. There was very little loss of appetite; the animal fed sparingly for two or three days, and then fed as usual. The swelling remained for some time, becoming less painful, and had not entirely disappeared when she was disposed of three weeks later.

Whether this inoculation would protect the heifer if she had been introduced into an infected pasture, is a question; it very probably would. Furthermore, would the germ introduced into the subcutaneous tissue of the shoulder act in all cases as it did with this animal, or, if tried on a larger scale, would it act fatally in some cases? A single experiment proves nothing, beyond suggesting the importance and necessity of further study, and experimentation upon a sufficiently large scale to lay a foundation upon which to base correct conclusions.

Kitt is quoted, in Freidberger and Fröhner's "Pathology and Therapeutics of the Domestic Animals," fourth German edition, Vol. 2, page 416, as saying that animals inoculated with cultures of the blackleg bacillus are given immunity from natural infection; but it would require further study of the behavior of the bacillus separated from the Worcester County disease before it could be decided that this was the case there.

In the fifteenth annual report of the Bureau of Animal Industry, 1898, there is a very interesting report upon blackleg by Dr. Victor A. Nörgaard, in which he gives an account of its history, geographical distribution, distribution in the United States, symptoms, post-mortem appearances and prevention, to which the reader is referred for more detailed information. Nörgaard says that in ninety-nine per cent. of all the cases the tumors develop on the surface of the body; and this would seem to indicate that the

infection takes place through the skin; in fact, deeper-seated muscles, such as the diaphragm or tenderloin, are very rarely affected. He says: "It is doubtful if infection ever takes place through ingestion. In any case it has proved exceedingly difficult to produce the disease, even by feeding enormous doses of highly virulent material to susceptible animals."

The name of the disease, blackleg, is a popular one, based upon its symptoms and lesions. It has been known as quarter-evil as well as blackleg, because it usually attacks one quarter of the animal, causing a swelling, with formation of gas under the skin, which causes it to crackle on pressure; the surrounding tissues are infiltrated with blood or bloody serum, and the adjacent muscles are dark brown or black, and easily torn. Comparing these appearances with most of those described as occurring among the young cattle of Worcester County, it would seem that, if the disease there was blackleg, it was certainly a peculiar form. In the majority of cases where post-mortem examinations were made the lesions were chiefly in the throat, in the walls of the pharynx, the roof of the tongue, the glottis and surrounding tissues. These lesions were quite constant in the animals that died within a day or two of being taken sick; in animals that lived several days the lesions were then found in other parts of the alimentary canal, and the patients presented symptoms of generally sick animals, having a high temperature and loss of appetite, but no swellings upon the surface of the body or legs, as described as being among the symptoms of blackleg.

The one inoculation experiment upon a heifer did not produce the results that might be expected from the hypodermic injection of a large quantity of the bacillus of blackleg, but a single experiment of this kind is not conclusive.

The disease is spoken of as blackleg in this report because the bacillus found by Drs. Smith and Coolidge resembles so closely the blackleg bacillus; but, if it is the same, it seems to be a modified form, having an affinity for the digestive tract instead of a tendency to produce its lesions in the muscles near the surface of the body and the subcutaneous connective tissue.

It is possible infection took place through injuries from coarse food, instead of through punctured wounds of the skin, which Nörgaard suggests may be the usual mode of infection.

The United States Bureau of Animal Industry furnishes an inoculating outfit and an attenuated blackleg virus for the protective inoculation of young cattle upon farms where blackleg exists, and the results have been very gratifying in diminishing the ravages of this disease. The Bureau of Animal Industry about the first of September sent one of these outfits to Mr. Herrick, upon application from the Board of Cattle Commissioners. Mr. Herrick notified the farmers of Hubbardston and vicinity that he was prepared to furnish the protective inoculation, at their risk if they desired it, but that occasionally an animal inoculated might die. As the disease had commenced to subside by that time, no one availed himself of this offer. It may be as well that none of the farmers cared to avail themselves of this opportunity, as there is a possibility that their pastures might have been infected through this means with a different form of the disease than that already there, or even that true blackleg and the disease occurring in Worcester County may be totally distinct, and thus the pastures might have become contaminated with another disease, in addition to the one already there.

The last two summers have been excessively dry, and the summer of 1900 was one of not only great drought, but great heat as well. It may be that these unusual meteorological conditions were conducive to the production and development of a germ which will disappear under more normal conditions, or it may be that these pastures may become permanently infected. In the latter case, it will become incumbent upon the Cattle Commissioners to devise some method of prophylaxis for the protection of the young cattle in these districts.

Owing to the scarcity of forage during the last season, the young animals may have been driven to eating coarse grasses, sedges, briars and similar material, which might cause scratches and abrasions in the mouth and throat, by which germs might gain access to deeper tissues and pro-

duce disease; while in ordinary years food of a more succulent character would be eaten, which would not injure the mouth or throat, and thus these germs would produce no bad results, even if a few were present in the food.

How the disease spread is an interesting question. Where the animals were kept unburied, as they were at first, it could be seen that foxes had been working at the remains, eating them and pulling them about. It is possible that foxes or birds might carry the disease from one pasture to another, voiding the bacilli and spores in their excrement, even although these germs were harmless to their bearers. Certain it is that when the Cattle Commission insisted upon having the carcasses burned or carefully buried the disease commenced to diminish.

This disease is certainly one worthy of further investigation and experimentation, and, if it should become of a permanent character, no doubt it will be possible to determine upon some means for its prevention. It is the opinion of Dr. Theobald Smith that it would be better to attempt to prepare a virus for protective inoculation from the germ already there than to blindly adopt the use of the material for the prevention of blackleg furnished by the Bureau of Animal Industry, until it is proved that the disease in Worcester County is identical with blackleg, and not a different form of the malady, or possibly a distinct disease. In fact, it cannot be too strongly emphasized that it would be a very unwise plan to use a blackleg preventive vaccine, for fear of infecting the pastures with another disease, until it is conclusively proven that true blackleg and the disorder described here are identical.

Texas Fever.

There has been no Texas fever in Massachusetts during the summer of 1900, neither has there been for several years. The commission has taken the usual precautions; that is, cattle brought in during the summer months from infected districts can only be brought in for immediate slaughter, and must be unloaded at the slaughter house and not driven into pens or over streets that are used for northern cattle. The regulations of the United States Bureau

of Animal Industry relating to Texas fever are an additional safeguard. The cars having cattle from localities where Texas fever exists are placarded; that is, a placard is tacked upon them, stating that the cattle are from quarantine districts, and that they cannot be yarded in pens used for northern cattle, or driven over runways or roads upon which northern cattle are likely to be driven. These regulations have had the effect of reducing the danger to Massachusetts cattle from Texas fever very much, compared to several years ago.

Rabies.

Very few cases of rabies have been reported to the Cattle Commission during the last year. Rabbits were inoculated with material from the brains of three dogs, sent in during the autumn of 1899, which did not develop any symptoms of rabies at the expiration of three months after the beginning of last year; these three dogs, therefore, were not rabid.

The head of a dog owned in Newton was sent in January 8. The dog had bitten two children, and was killed; it was thought advisable to be sure that he was not rabid. A rabbit and guinea pig inoculated January 9 were still healthy April 28; the dog, therefore, was free from this disease.

There were but two other cases of supposed rabies reported, and neither of these was verified by inoculating rabbits or guinea pigs. One was reported from Fall River, the other from Weston. It does not seem improbable now that the Weston case may have been one of rabies, as, at the time of preparing this report, an outbreak of rabies was reported among dogs in Watertown, Waltham and Belmont, The Cattle Commission hoped rabies had been practically eradicated from among the dogs in this Commonwealth, as such an interval had elapsed since the occurrence of an authentic case. The last one which was proved to have been true rabies was in March, 1899. It is, therefore, a disappointment to hear of the new outbreak to which we have just alluded.

Swine Diseases.

During the past year eleven outbreaks of hog cholera, or diseases supposed to be hog cholera, have been reported among swine. In addition to these, one case of tuberculosis was reported in a pig in Townsend, which was ordered killed by the Board, and was found to have this disease.

When an outbreak of hog cholera occurs, all it seems possible for the commission to do is to quarantine the premises, and forbid owners to buy or sell any swine until the disease has disappeared. This is usually accomplished by killing the badly diseased, waiting until the sick ones have recovered and no new cases appear, then disinfect the pens. Occasionally where there is a bad outbreak an owner prefers to kill all his swine, disinfect the pens and restock with healthy animals.

Outbreaks of hog cholera have been reported from Colrain, Lee, Brockton, Greenfield, Brookline, Medfield, Westfield, Stockbridge and Sterling.

The outbreak in Sterling was found to be due to pneumonia late in the fall, as a result of not housing the swine properly. These reports involve 523 animals; 420 were released, the others having died or been killed. Those released were the animals left after the outbreaks had subsided.

Where hog cholera appears in a herd of swine, if the animals are large and ready for market, perhaps the best course to pursue is to kill all of them for pork, when all that are found to be free from disease can be utilized and the others sent to the renderers. In a number of cases there seems to be no doubt that hog cholera or swine plague may be caused by feeding swill that has been kept some little time, and not cooked. The germs of hog cholera may perhaps be obtained from uncooked swill, as a result of throwing refuse from western pork into it. Swine plague may be produced by the germs of the disease developing in the putrefying swill. The swill from large public institutions, and city swill, seems to be especially dangerous, and should always be cooked before being fed. Small quantities of house swill fed fresh daily to pigs kept at home is less dangerous.

An agent of the Society for the Prevention of Cruelty to Animals telephoned September 13, reporting a disease in pigs in Agawam resembling mange. An agent of the Board was sent to Springfield September 15, and proceeded to Agawam. He reported that, in his opinion, the pigs had eczema; that they were in a dirty, dusty pen, and the dust collected upon them, making thick scabs after the eczema appeared. He advised a change of food, as they were then getting distillery slops, and also advocated letting them run in the fields, where they could get some green food, and where it would not be so dusty. Nothing has been heard of this trouble further, so it is hoped that the change of food and care was beneficial.

Miscellaneous.

February 23, Dr. C. H. Playdon of Reading reported what he thought might be a contagious disease among cattle on a farm in Saugus. The chairman of the Board and Dr. Langdon Frothingham visited the farm February 24, and found five cows had died and five more were sick; eleven cows and one bull were healthy. The animals that were sick seemed to be grinding their teeth, leaning forward in the stanchions, and those that were very sick would get down and seem unable to rise before death took place. Post-mortems were made on some of the animals that were dead, and the blood was black and tarry, and some of them showed little patches of broncho-pneumonia, but not all. Cultures were taken by Dr. Frothingham from the blood and various organs, but he did not succeed in finding any pathogenic germs. One peculiar thing in this case was that there was no rise in temperature; the sick animals did not seem to be feverish, their temperatures remaining normal. The food seemed to be of the usual quality: salt marsh hay, English hay, Chicago gluten meal, bran, corn meal and a little steamed linseed meal. The water supply came from a well a little distance from the barn, and seemed to be of good quality. The second visit was made by the chairman and Mr. Dennen, March 1, when the eleven cows and the bull, which were quarantined February 24, were released, as they remained healthy. Four quarantined cows that

were sick were killed by a butcher, who bought the hides and carcasses to be sold to a renderer. Mr. Dennen suggested that the animals showed symptoms of lead poisoning, and thought, if some of the organs had been analyzed, instead of examined for bacteria, lead might have been found. In this instance ten animals out of twenty-two died.

Boston, April 5, Dr. C. A. Keene of Fitchburg notified the Cattle Commission of a supposed outbreak of a contagious disease in Westminster. The chairman of the Board at once went to Fitchburg, and with Dr. Keene visited the farm where the sick animals were. Six cattle had died, four were sick and eight were in a lane back of the barn, apparently well. These animals presented much the same symptoms as those in Saugus; there was no rise in temperature, the animals staggered and stood pressing forward in the stanchions, and finally seemed unable to stand, fell down and could not rise again. Post-mortems were made on three, but no well-marked lesions were found. One animal, which was nearly dead, was killed, and specimens were taken, consisting of a bit of heart muscle, bit of liver, bit of kidney and a piece of the spleen, and were sent to Dr. Frothingham for examination. Remembering the suggestion that the animals in Saugus might have lead poisoning, part of the contents of the third and fourth stomachs, bit of small intestine and a portion of the lungs were taken from the one that was killed and the one that died in the morning, and sent to Dr. Chas. Harrington of Boston, to be analyzed, in order to see whether the animals had been poisoned in any way. Dr. Harrington was unable to detect any of the common poisons in the specimens sent him, and Dr. Frothingham found no pathogenic germs in the material sent him. The causes of these two outbreaks of disease, which appeared to be identical in character, are, therefore, mysterious. If any similar cases are reported another winter or spring, it is hoped that some reason for their occurrence may be discovered.

July 30, a farmer in Weston found a cow dead in the pasture, and on the 31st two died in another pasture. The chairman of the Board made post-mortems on the two that died July 31, but all that could be found was an inflammation of

the small intestine in one and of the small and large intestines in the other; in each cow the interior surface of the small intestines were covered by a purulent mucus. Specimens from the spleen, liver, kidney, heart and small intestines from one cow were taken to Dr. Theobald Smith, who could not find any germs of disease. Some of the portions of the intestines, lungs and kidneys were also taken to Dr. Chas. Harrington for analysis, and he reported that he could not find any of the common irritant poisons. It seems that these cases must have been the result of the cows eating something that disagreed with them, causing acute inflammation of the intestines. As it was hot weather, it is possible that some toxic substance was produced, as a result of the decomposition of some of the food, which may have produced fatal results.

Respectfully submitted,

AUSTIN PETERS, *Chairman*,
LEANDER F. HERRICK, *Secretary*,
CHARLES A. DENNEN,
Board of Cattle Commissioners.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1900.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When Incorporated.	Amount originally raised by Contribution. (P. S., Chap. 114, Sects. 1 and 2.)	Amount now held Invested as a Capital Stock. (P. S., Chap. 114, Sects. 2 and 10.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural),	1881	$1,002 32	[2] $8,259 21	$8,259 21	$8,259 21
2	Barnstable County,	1844	1,740 00	[3] 8,300 00	8,300 00	8,752 45
3	Berkshire,	1811	3,000 00	[4] 12,000 00	12,200 00	13,330 73
4	Blackstone Valley,	1884	3,000 00	[5] 4,500 00	4,500 00	4,500 00
5	Bristol County,	1823	3,240 00	[4] 32,000 00	32,400 00	32,445 54
6	Deerfield Valley,	1871	4,094 01	[4] 9,200 00	9,450 00	9,450 00
7	Eastern Hampden,	1856	3,000 00	[6] 7,019 68	7,000 00	7,019 68
8	Essex,	1818	4,547 20	[7] 27,980 00	27,980 00	27,980 00
9	Franklin County,	1850	3,768 00	[8] 7,000 00	7,064 77	7,056 77
10	Hampshire,	1814	3,255 26	[5] 4,352 43	4,352 43	4,655 38
11	Hampshire, Franklin and Hampden,	1818	3,141 29	[9] 1,674 85	1,674 85	1,674 85
12	Highland,	1859	3,262 00	[5] 3,262 00	3,150 00	3,256 90
13	Hillside,	1883	3,113 32	[10] 5,431 15	5,431 15	5,796 47
14	Hingham (Agricultural and Horticultural),	1867	17,406 15	[5] 22,000 00	22,000 00	22,746 57
15	Hoosac Valley,	1860	2,006 00	[5] 16,800 00	16,800 00	17,809 02
16	Housatonic,	1848	6,335 33	[11] 24,369 23	24,844 23	24,973 35
17	Manufacturers' Agricultural of North Attleborough,	1896	10,000 00	[5] 10,000 00	10,000 00	10,218 34
18	Marshfield (Agricultural and Horticultural),	1867	3,755 43	[5] 14,050 00	14,050 00	14,050 00
19	Martha's Vineyard,	1859	4,552 17	[10] 4,264 34	4,264 34	4,352 16
20	Massachusetts Horticultural,	1829	525 00	[12] 564,524 70	826,531 95	826,531 95
21	Massachusetts Society for Promoting Agriculture,[1]	1792	–	–	–	–
22	Middlesex North,	1855	8,000 00	[4] 50,000 00	50,300 00	50,740 00
23	Middlesex South,	1854	3,000 00	[4] 12,000 00	12,200 00	12,205 97
24	Nantucket,	1856	3,500 00	[4] 3,200 00	3,200 00	3,779 63
25	Oxford,	1888	4,400 00	[3] 8,872 88	8,872 88	8,872 88
26	Plymouth County,	1819	9,550 00	[13] 1,458 40	1,408 41	1,458 40
27	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[5] 8,950 00	8,950 00	8,950 00
28	Union (Agricultural and Horticultural),	1867	4,447 23	[5] 9,000 00	9,000 00	9,169 67
29	Weymouth (Agricultural and Industrial),	1891	10,270 00	[5] 11,270 00	11,270 00	11,602 03
30	Worcester,	1818	7,730 00	[10] 119,500 85	119,500 85	119,900 85
31	Worcester East,	1890	2,296 23	[10] 6,603 80	6,603 80	6,603 80
32	Worcester North-west (Agricultural and Mechanical),	1867	3,400 00	[5] 8,585 28	12,600 00	12,600 00
33	Worcester South,	1855	3,127 40	[5] 10,900 00	10,900 00	11,206 25
34	Worcester County West,	1851	3,175 00	[5] 13,600 00	14,289 89	14,289 89
			$151,673 34	$1,050,928 80	$1,319,338 76	$1,326,238 74

[1] Made no returns.
[2] Invested in real estate, cash, crockery, tables, etc.
[3] Invested in real estate and bonds.
[4] Invested in real estate.
[5] Invested in real estate, crockery, tables, etc.
[6] Invested in real estate, bills due and cash.
[7] Invested in real estate, stocks, crockery, tables, etc.

Societies for the Year ending Dec. 31, 1900.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills Due and Unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,806 88	-	-	-	-	$269 89	$182 44	$1,600 00	1
7,500 00	-	$800 00	-	-	-	452 45	1,950 00	2
12,000 00	-	-	-	-	200 00	1,130 73	9,759 99	3
4,400 00	-	-	-	-	100 00	-	2,036 90	4
32,000 00	-	-	-	-	400 00	45 54	15,302 50	5
9,200 00	-	-	-	-	250 00	-	182 98	6
7,000 00	-	-	-	$8 20	-	11 48	5,025 82	7
15,300 00	-	12,480 00	-	-	200 00	-	-	8
6,000 00	-	1,000 00	$54 77	2 00	-	-	3,896 00	9
4,200 00	-	-	-	-	152 43	302 95	1,313 00	10
-	-	-	206 45	-	1,000 00	468 40	123 04	11
3,000 00	-	-	-	-	150 00	106 90	-	12
4,500 00	-	-	581 15	-	350 00	365 32	-	13
20,000 00	-	-	-	600 00	2,000 00	146 57	300 00	14
16,300 00	-	-	-	-	500 00	1,009 00	10,000 00	15
22,000 00	-	1,000 00	1,369 23	10 00	475 00	119 12	6,562 00	16
9,500 00	-	-	-	-	500 00	218 34	-	17
13,300 00	-	-	-	-	750 00	-	3,220 90	18
2,750 00	$300 00	-	964 34	3 00	250 00	84 82	11 50	19
318,442 70	134,684 21	245,338 50	70,529 77	5,435 34	47,766 47	4,334 96	8,275 00	20
-	-	-	-	-	-	-	-	21
50,000 00	-	-	-	-	300 00	440 00	16,420 00	22
12,000 00	-	-	-	-	200 00	5 97	8,000 00	23
3,200 00	-	-	-	572 94	-	6 69	572 94	24
7,375 00	-	-	-	-	200 00	1,297 88	-	25
-	-	-	1,371 41	-	37 00	49 99	60 00	26
8,000 00	-	-	-	-	950 00	-	950 00	27
8,000 00	-	-	-	-	1,000 00	169 67	1,885 75	28
11,000 00	-	-	-	-	270 00	332 03	1,500 00	29
68,592 10	-	-	50,308 75	-	600 00	300 00	5,300 00	30
5,671 03	-	-	372 22	-	560 55	-	-	31
12,000 00	-	-	-	-	600 00	-	4,014 72	32
10,600 00	-	-	-	-	300 00	306 25	2,170 14	33
12,600 00	-	-	-	-	1,000 00	689 89	-	34
$724,237 71	$134,984 21	$260,618 50	$125,758 09	$6,631 48	$61,331 34	$12,577 39	$110,433 18	

[8] Invested in real estate and stocks.
[9] Invested in personal property.
[10] Invested in real estate, bank funds, crockery, tables, etc.
[11] Invested in real estate, stocks and bank funds.
[12] Invested in real estate, library, furniture, bonds and other securities.
[13] Invested in bank funds, cash, crockery, tables, etc.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	Premiums Due and Unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural),	-	-	$1,600 00	$2,266 78	$600 00	-
2	Barnstable County,	-	-	1,950 00	5,732 79	600 00	-
3	Berkshire,	-	$959 99	8,800 00	7,508 31	[2]1,129 25	-
4	Blackstone Valley,	-	86 90	1,950 00	2,066 30	541 57	-
5	Bristol County,	-	302 50	15,000 00	21,757 62	600 00	-
6	Deerfield Valley,	-	182 98	-	2,243 23	600 00	-
7	Eastern Hampden,	-	535 12	4,490 70	2,897 41	600 00	-
8	Essex,	-	-	-	3,744 77	600 00	-
9	Franklin County,	-	30 00	3,766 00	6,398 47	600 00	$974 85
10	Hampshire,	-	-	1,313 00	2,199 63	600 00	-
11	Hampshire, Franklin and Hampden,	$123 04	-	-	3,340 50	394 08	17 45
12	Highland,	-	-	-	1,665 63	600 00	-
13	Hillside,	-	-	-	1,668 74	600 00	22 82
14	Hingham (Agricultural and Horticultural),	-	-	300 00	4,424 49	600 00	-
15	Hoosac Valley,	-	-	10,000 00	4,532 66	600 00	-
16	Housatonic,	-	50 00	6,512 00	10,668 28	600 00	44 12
17	Manufacturers' Agricultural of North Attleborough,	-	-	-	1,734 97	205 00	-
18	Marshfield (Agricultural and Horticultural),	10 90	-	3,210 00	3,203 89	600 00	-
19	Martha's Vineyard,	5 00	6 50	-	1,155 85	600 00	55 73
20	Massachusetts Horticultural,	8,275 00	-	-	637,999 85	600 00	3,004 39
21	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-
22	Middlesex North,	120 00	-	16,300 00	5,894 44	600 00	-
23	Middlesex South,	-	-	8,000 00	1,996 39	600 00	-
24	Nantucket,	-	572 94	-	1,228 06	600 00	-
25	Oxford,	-	-	-	4,004 68	600 00	-
26	Plymouth County,	-	60 00	-	427 65	319 02	18 43
27	Spencer (Farmers' and Mechanics' Association),	-	250 00	700 00	2,592 53	600 00	-
28	Union (Agricultural and Horticultural),	85 25	130 50	1,650 00	2,324 93	600 00	-
29	Weymouth (Agricultural and Industrial),	-	-	1,500 00	4,402 73	600 00	-
30	Worcester,	-	300 00	5,000 00	10,841 71	600 00	1,876 97
31	Worcester East,	-	-	-	9,655 46	600 00	13 41
32	Worcester North-west (Agricultural and Mechanical),	-	-	4,014 72	4,883 29	600 00	-
33	Worcester South,	70 14	-	2,100 00	3,638 50	600 00	-
34	Worcester County West,	-	-	-	3,160 85	600 00	-
		$8,689 33	$3,487 43	$98,156 42	$782,260 89	$19,388 92	$6,028 22

[1] Made no returns. [2] $529.25 from 1899.

SOCIETIES FOR THE YEAR ENDING DEC. 31, 1900 — Concluded.

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from all Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
-	$21 00	-	$1,645 78	$2,192 50	$892 10	$213 75	$101 18	$985 47	1
$20 00	55 00	$1,387 25	3,670 54	5,280 45	2,036 20	1,718 58	175 61	1,850 00	2
-	26 00	-	6,358 06	8,103 35	[3] 1,942 00	3,324 09	573 25	2,264 01	3
-	21 00	17 05	1,436 68	2,066 30	570 00	1,253 39	65 00	177 91	4
-	-	19 00	21,138 62	22,014 58	6,330 15	7,717 99	631 18	7,335 36	5
-	12 00	7 90	1,623 33	1,941 69	1,109 05	689 04	15 20	128 40	6
-	15 00	111 09	2,171 32	2,897 41	1,559 95	-	-	1,337 46	7
729 83	87 00	504 00	1,823 94	3,037 62	[4] 1,465 45	720 41	366 08	485 68	8
40 00	-	-	4,783 62	6,343 70	1,309 25	4,268 84	165 61	600 00	9
-	35 00	80 48	1,434 15	1,896 68	657 95	659 35	79 38	500 00	10
-	93 00	-	2,835 97	2,925 79	1,040 76	1,277 14	-	607 89	11
-	22 00	-	1,043 63	1,558 73	618 45	916 18	3 76	20 34	12
-	92 00	10 65	943 27	1,408 00	752 50	456 08	-	194 52	13
-	5 00	208 50	3,610 99	4,280 51	943 45	1,196 89	17 75	2,122 42	14
-	-	-	3,932 66	3,755 15	975 65	1,472 30	404 85	892 35	15
50 00	145 00	10 00	9,819 16	10,549 16	2,052 52	3,813 22	289 50	4,393 92	16
-	-	-	1,529 97	1,775 85	475 00	1,255 67	-	45 18	17
-	45 00	305 00	1,253 39	3,019 63	1,297 17	861 12	210 81	650 58	18
-	40 00	4 85	455 27	1,115 95	643 33	282 52	-	190 10	19
7,490 77	[5] 1,554 00	2,541 09	622,809 60	352,139 41	[4] 7,720 52	27,507 43	4,025 00	312,886 46	20
-	-	-	-	-	-	-	-	-	21
-	18 00	-	5,276 44	4,088 45	825 25	1,731 20	542 00	1,570 00	22
-	45 00	33 05	1,318 34	1,990 42	695 85	650 84	75 00	568 73	23
-	24 00	-	604 06	1,221 37	612 00	609 37	-	-	24
-	31 00	16 25	3,957 43	2,706 80	1,397 04	350 00	-	959 76	25
-	-	12 65	77 50	472 78	300 00	40 59	-	132 19	26
-	25 00	-	1,967 53	2,674 73	1,577 95	1,043 76	53 02	-	27
-	49 00	-	1,675 93	2,155 26	1,175 25	897 51	82 50	-	28
-	-	4 42	3,798 31	4,441 23	681 77	150 00	75 00	3,534 46	29
-	60 00	25 00	8,279 74	16,141 03	4,478 50	6,788 53	-	4,874 00	30
-	119 00	363 00	8,560 05	8,093 13	1,075 00	7,018 13	-	-	31
-	60 00	-	4,223 29	4,883 29	2,388 30	2,272 80	222 19	-	32
-	51 00	-	2,987 50	3,399 65	1,974 73	1,314 92	110 00	-	33
-	65 00	30 25	2,465 60	3,074 72	1,633 45	1,441 27	-	-	34
$8,330 60	$2,815 00	$5,691 48	$739,606 67	$493,640 32	$53,206 54	$83,932 86	$8,283 87	$348,807 15	

[3] $1,038.50 awarded in 1899. [4] Awarded in 1899. [5] And assessments.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.
1	Amesbury and Salisbury,[1]	$1,600 00	$905 00	$892 10	$80 00	-	-
2	Barnstable County,	2,438 00	2,036 20	2,036 20	123 00	-	-
3	Berkshire,	1,413 50	903 50	903 50	-	-	-
4	Blackstone Valley,	900 00	572 50	570 00	45 00	$45 00	$45 00
5	Bristol County,	7,474 00	6,330 15	6,330 15	234 00	64 00	64 00
6	Deerfield Valley,	1,435 25	1,116 95	1,109 05	-	-	-
7	Eastern Hampden,	2,020 25	1,559 95	1,559 95	24 00	24 00	24 00
8	Essex,	2,702 50	1,807 55	[2] 1,465 45	200 00	16 00	[2] 40 00
9	Franklin County,	1,459 90	1,309 25	1,309 25	-	-	-
10	Hampshire,	898 75	657 95	657 95	25 00	-	-
11	Hampshire, Franklin and Hampden,	1,530 50	1,163 80	1,040 76	50 00	-	-
12	Highland,	827 30	618 45	618 45	-	-	-
13	Hillside,	800 00	752 50	752 50	3 00	3 00	3 00
14	Hingham,[1]	2,122 80	943 45	943 45	250 75	6 00	6 00
15	Hoosac Valley,	1,881 25	975 65	975 65	-	-	-
16	Housatonic,	2,776 75	2,052 52	2,052 52	-	-	-
17	Manufacturers' Agricultural of North Attleborough,	736 65	475 00	475 00	-	-	-
18	Marshfield,[1]	1,915 00	1,313 07	1,297 17	110 00	-	-
19	Martha's Vineyard,	1,017 72	665 27	665 27	30 00	5 00	5 00
20	Massachusetts Horticultural,	10,461 50	7,768 52	[2] 7,720 52	677 00	475 00	[2] 562 00
21	Massachusetts Society for Promoting Agriculture,[2]	-	-	-	-	-	-
22	Middlesex North,	1,298 65	825 25	825 25	-	-	-
23	Middlesex South,	1,523 75	695 85	695 85	45 00	17 00	17 00
24	Nantucket,	1,385 75	612 00	612 00	226 00	9 00	9 00
25	Oxford,	1,800 00	1,427 25	1,397 04	78 00	47 00	46 50
26	Plymouth County,	320 00	300 00	300 00	-	-	-
27	Spencer (Farmers' and Mechanics' Association),	2,000 00	1,577 95	1,577 95	52 00	27 00	27 00
28	Union,[1]	1,828 75	1,260 50	1,175 25	10 00	5 00	5 00
29	Weymouth (Agricultural and Industrial),	1,160 00	696 22	681 77	8 50	-	-
30	Worcester,	6,960 00	4,478 50	4,478 50	-	-	-
31	Worcester East,	1,600 00	1,128 00	1,075 00	-	-	-
32	Worcester North-west (Agricultural and Mechanical),	2,778 15	2,586 40	2,388 30	30 00	29 00	29 00
33	Worcester South,	2,525 00	1,961 07	1,974 73	143 00	42 00	42 00
34	Worcester County West,	1,937 00	1,695 70	1,633 45	66 00	34 00	34 00
		$73,528 67	$53,171 92	$52,189 98	$2,510 25	$848 00	$958 50

[1] And horticultural.

[2] Held no fair and made no returns.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1900.

Amount offered under Head of Farm and Pet Stock.	Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	
$761 00	$336 50	$336 50	$180 00	$5 00	$5 00	$240 00	$200 25	$199 55	$8 25	1
625 50	482 50	482 50	149 00	41 50	41 50	289 00	260 70	260 70	10 00	2
1,098 00	578 50	578 50	-	-	-	155 25	134 75	134 75	31 00	3
525 00	368 50	368 50	-	-	-	115 00	80 55	78 05	5 50	4
2,246 75	1,710 75	1,710 75	205 00	62 00	62 00	451 00	394 75	394 75	32 00	5
840 00	580 00	574 50	-	-	-	75 75	68 20	67 65	12 00	6
711 00	502 00	502 00	-	-	-	187 00	132 00	132 00	18 00	7
1,350 50	677 50	[3] 776 50	272 00	29 00	[3] 36 00	485 00	440 75	[3] 360 00	16 00	8
1,046 90	997 10	997 10	66 00	34 70	34 70	152 00	127 70	127 70	22 00	9
520 00	336 75	336 75	44 00	-	-	176 75	125 25	125 25	13 00	10
1,031 00	827 05	779 23	79 00	31 00	22 00	205 50	180 75	157 26	36 00	11
419 00	374 50	374 50	35 00	14 00	14 00	47 75	44 70	44 70	9 00	12
444 50	444 50	444 50	50 00	43 50	43 50	87 00	79 35	79 35	11 00	13
881 75	399 50	399 50	91 00	20 00	20 00	511 55	270 85	270 85	6 00	14
1,225 00	403 00	403 00	-	-	-	161 75	117 65	117 65	44 00	15
1,636 75	1,108 75	1,108 75	254 00	248 00	248 00	353 00	312 00	312 00	42 00	16
334 00	256 50	256 50	-	-	-	175 90	137 25	137 25	3 75	17
342 50	309 90	296 90	110 50	3 00	3 00	263 00	201 95	183 70	12 00	18
481 45	265 00	265 00	170 50	59 60	59 60	47 00	126 42	126 42	13 00	19
-	-	-	-	-	-	9,784 50	7,012 00	[3] 7,336 02	-	20
-	-	-	-	-	-	-	-	-	-	21
836 00	450 00	450 00	-	-	-	423 00	252 25	252 25	4 50	22
827 00	191 25	191 25	-	-	-	180 20	55 10	55 10	6 00	23
670 00	346 50	346 50	140 00	6 75	6 75	103 00	67 00	67 00	16 00	24
837 00	603 00	584 50	31 00	22 50	21 63	84 00	41 50	38 33	12 00	25
164 00	145 00	145 00	-	-	-	73 00	73 00	72 00	-	26
755 50	587 00	587 00	-	-	-	193 25	127 25	127 25	12 00	27
800 00	446 75	410 75	100 00	66 50	62 00	54 75	42 25	38 75	12 75	28
758 70	337 20	332 60	46 00	3 00	3 00	164 95	163 95	160 00	5 50	29
2,871 00	1,238 50	1,238 50	-	-	-	401 50	326 00	326 00	42 00	30
900 00	703 00	703 00	125 00	93 00	93 00	150 00	96 00	96 00	20 00	31
947 75	815 75	698 50	-	-	-	142 25	120 25	108 00	24 00	32
743 68	694 32	641 74	-	-	-	198 25	143 00	140 75	16 00	33
871 00	709 60	693 98	-	-	-	122 75	111 30	99 92	15 00	34
$28,502 23	$18,226 67	$18,014 80	$2,148 00	$783 05	$775 68	$16,254 60	$12,066 67	$12,226 95	$525 25	

[3] Awarded in 1899, paid in 1900.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP

	SOCIETIES.	Amount awarded under Head of Dairy Products.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.
1	Amesbury and Salisbury,[1] . .	$3 25	$3 25	$125 00	$114 00	$114 00	$246 00
2	Barnstable County, ...	5 00	5 00	208 00	213 00	213 00	233 50
3	Berkshire, ...	15 00	15 00	129 25	119 25	119 25	56 00
4	Blackstone Valley, ...	2 00	2 00	50 00	32 75	32 75	43 70
5	Bristol County, ...	29 50	29 50	370 00	286 85	286 85	172 30
6	Deerfield Valley, ...	12 00	12 00	98 00	81 25	80 40	60 50
7	Eastern Hampden, ...	8 00	8 00	58 00	35 95	85 95	8 75
8	Essex, ...	-	[11] 1 00	204 00	136 70	[11] 102 95	175 50
9	Franklin County, ...	8 00	8 00	145 00	113 75	113 75	28 00
10	Hampshire, ...	3 00	3 00	58 00	55 95	55 95	137 00
11	Hampshire, Franklin and Hampden, ...	16 00	9 00	102 00	45 75	26 64	63 25
12	Highland, ...	8 00	8 00	79 00	70 00	70 00	27 25
13	Hillside, ...	3 00	3 00	88 00	76 65	76 65	42 50
14	Hingham,[1]	6 75	6 75	103 75	98 85	98 85	141 50
15	Hoosac Valley, ...	23 25	23 25	316 50	297 75	297 75	134 00
16	Housatonic, ...	41 00	41 00	481 00	390 50	390 50	[3] 1,097 20
17	Manufacturers' Agricultural of North Attleborough, . . .	1 00	1 00	124 50	46 00	46 00	34 25
18	Marshfield,[1]	5 00	5 00	139 50	155 22	150 72	46 75
19	Martha's Vineyard, . . .	11 25	11 25	103 25	157 80	157 80	40 20
20	Massachusetts Horticultural, .	-	-	-	-	-	-
21	Massachusetts Society for Promoting Agriculture,[2]	-	-	-	-	-	-
22	Middlesex North, ...	-	-	117 50	81 25	81 25	41 75
23	Middlesex South, ...	-	-	83 25	35 20	32 50	-
24	Nantucket, ...	3 00	3 00	116 00	65 00	65 00	34 75
25	Oxford, ...	8 00	8 00	49 50	34 00	28 94	6 25
26	Plymouth County, ...	-	-	63 00	63 00	63 00	20 00
27	Spencer (Farmers' and Mechanics'),	7 00	7 00	83 75	65 75	65 75	34 50
28	Union,[1]	8 75	8 75	102 65	89 20	66 84	42 05
29	Weymouth (Agricultural and Industrial), ...	4 00	3 50	150 15	128 90	125 05	59 17
30	Worcester, ...	7 00	7 00	134 25	76 00	76 00	25 00
31	Worcester East, ...	8 00	8 00	200 00	158 00	158 00	70 00
32	Worcester North-west (Agricultural and Mechanical), . . .	8 00	8 00	75 40	54 65	35 05	75 00
33	Worcester South, ...	14 00	14 00	84 00	73 00	71 50	29 75
34	Worcester County West, . .	5 00	5 00	62 00	47 30	44 05	8 50
		$273 75	$267 25	$4,304 20	$3,499 22	$3,382 69	$3,234 87

[1] And horticultural.
[2] Held no fair and made no returns.
[3] Including sports, etc.
[4] Sports.
[5] And gratuities.

AND INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1900 — Concluded.

Amount paid under Head of Miscellaneous.	Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institutes held.	Average Number attending Institutes.	
$233 80	-	339	122	19	$68 15	210	36	216	4	90	1
233 50	$800 00	115	300	9	-	326	210	536	3	67	2
56 00	847 50	197	-	24	18 25	664	100	764	3	31	3
43 70	-	89	13	13	-	287	280	567	3	20	4
172 30	3,610 00	534	11	51	556 75	639	197	836	3	58	5
59 50	315 00	[5] 250	-	20	-	1,062	192	1,254	3	92	6
8 75	850 00	104	-	21	-	288	195	483	3	87	7
[11] 132 75	-	403	-	30	-	1,221	16	1,237	3	112	8
28 00	800 00	275	5	28	108 00	[7] 1,500	[7] 200	[7] 1,700	3	57	9
137 00	500 00	140	1	15	-	521	197	718	3	70	10
46 63	517 50	183	18	27	-	[8] 840	[8] 223	[8] 1,063	4	78	11
27 25	80 00	144	-	18	-	263	119	382	4	67	12
42 50	60 00	315	-	25	-	645	37	682	4	113	13
141 50	-	115	235	20	-	463	187	650	5	35	14
134 00	1,042 50	202	-	18	92 35	964	16	980	3	16	15
[3] 1,097 20	1,800 00	423	-	21	35 00	1,556	49	1,605	3	33	16
34 25	200 00	116	39	7	4 50	55	51	106	3	107	17
41 75	612 00	72	283	28	-	572	311	883	3	55	18
40 20	[4] 12 30	198	-	6	-	103	87	190	3	67	19
-	-	214	124	84	224 00	789	92	881	10	222	20
-	-	-	-	-	-	-	-	-	-	-	21
41 75	-	123	121	12	-	925	-	925	4	200	22
-	380 00	87	40	7	-	362	211	573	3	62	23
34 75	80 00	217	83	1	-	225	360	585	4	16	24
4 14	665 00	101	-	23	-	350	284	634	3	135	25
20 00	-	-	-	-	-	800	600	1,400	4	50	26
34 50	795 00	138	-	19	-	484	324	808	3	58	27
28 70	465 00	183	61	23	3 00	628	731	1,359	3	158	28
57 62	-	400	300	24	-	480	10	490	3	23	29
25 00	2,776 50	[6] -	2	22	72 00	1,650	162	1,812	3	219	30
70 00	936 00	[5] 211	-	18	-	478	252	730	3	33	31
23 00	1,483 75	142	-	14	41 00	676	383	1,059	3	123	32
29 75	965 00	103	46	25	-	783	810	1,593	3	64	33
8 50	780 00	166	46	25	7 00	436	62	498	3	50	34
$3,088 29	$21,373 05	[9] 6,294	1,850	697	$1,230 00	21,245	6,984	28,229	115	[10] 89	

[6] No return made.
[7] Estimated.
[8] About.
[9] And gratuities for 2 societies.
[10] General average of attendance.
[11] Awarded in 1899, paid in 1900.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN THE STATE.

MARCH, 1901.

STATE BOARD OF AGRICULTURE, 1901.

Members ex Officio.

HIS EXCELLENCY W. MURRAY CRANE.
HIS HONOR JOHN L. BATES.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, PH.D., LL.D., *Chemist of the Board.*
JAMES W. STOCKWELL, *Secretary.*

Members appointed by the Governor and Council.

	Term Expires
WILLIAM R. SESSIONS of Springfield,	1902
FRANCIS H. APPLETON of Peabody,	1903
WARREN C. JEWETT of Worcester,	1904

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	F. W. SARGENT of Amesbury,	1903
Barnstable County,	JOHN BURSLEY of West Barnstable,	1904
Berkshire,	WESLEY B. BARTON of Dalton,	1903
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1903
Bristol County,	EDWARD M. THURSTON of Swansea (P. O. South Swansea),	1902
Deerfield Valley,	HENRY A. HOWARD of Colrain,	1902
Eastern Hampden,	O. E. BRADWAY of Monson,	1903
Essex,	JOHN M. DANFORTH of Lynnfield (P.O. Lynnfield Centre),	1902
Franklin County,	JOHN S. ANDERSON of Shelburne,	1904
Hampshire,	A. M. LYMAN of Montague,	1904
Hampshire, Franklin and Hampden,	H. C. COMINS of Northampton,	1903
Highland,	C. K. BREWSTER of Worthington,	1902
Hillside,	ALVAN BARRUS of Goshen (P.O. Lithia),	1902
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1903
Hoosac Valley,	GEO. P. CARPENTER of Williamstown (P. O. Blackinton),	1903
Housatonic,	CHARLES B. BENEDICT of Egremont,	1903
Man'f'trs' Agr'l (No. Attleborough),	OSCAR S. THAYER of Attleborough,	1903
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1903
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1904
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1903
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1903
Middlesex North,	JOSHUA CLARK of Tewksbury (P. O. Lowell),	1904
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1902
Nantucket,	J. S. APPLETON of Nantucket,	1903
Oxford,	W. M. WELLINGTON of Oxford,	1904
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1902
Spencer (Far's and Mech's Assoc'n),	JOHN G. AVERY of Spencer,	1904
Union (Agr'l and Hort'l),	ENOS W. BOISE of Blandford,	1904
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1903
Worcester,	J. LEWIS ELLSWORTH of Worcester,	1902
Worcester East,	W. A. KILBOURN of South Lancaster,	1903
Worcester North-west (Agr'l and Mech'l),	T. H. GOODSPEED of Athol (P. O. Athol Centre),	1904
Worcester South,	C. D. RICHARDSON of West Brookfield,	1904
Worcester County West,	CHAS. A. GLEASON of New Braintree,	1903

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . .	HIS EXCELLENCY W. MURRAY CRANE, *ex Officio*.
1st Vice-President,	WILLIAM R. SESSIONS of Springfield.
2d Vice-President, .	AUGUSTUS PRATT of North Middleborough.
Secretary, . .	JAMES W. STOCKWELL of Sutton.

Office, Rooms 134–136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. KILBOURN of South Lancaster.
ISAAC DAMON of Wayland.
JOHN BURSLEY of West Barnstable.
EDMUND HERSEY of Hingham.
FRANCIS H. APPLETON of Peabody.
AUGUSTUS PRATT of North Middleborough.
F. W. SARGENT of Amesbury.
J. L. ELLSWORTH of Worcester.

Committee on Agricultural Societies.

Messrs. W. A. KILBOURN of South Lancaster.
Q. L. REED of South Weymouth.
CHAS. A. GLEASON of New Braintree.
HENRY A. HOWARD of Colrain.
GEO. P. CARPENTER of Williamstown.

Committee on Domestic Animals and Sanitation.

Messrs. ISAAC DAMON of Wayland.
OSCAR S. THAYER of Attleborough.
JOSHUA CLARK of Tewksbury.
JOHNSON WHITING of West Tisbury.
JOHN S. ANDERSON of Shelburne.

Committee on Gypsy Moth, Insects and Birds.

Messrs. AUGUSTUS PRATT of North Middleborough.
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MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

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Houghton,	Lynn,	Walter B. Allen, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox,	Lenox,	Charles R. Russell, Stockbridge.	Jos. W. Martin, Lenox.
Massachusetts,	The State,	O. B. Hadwen, Worcester.	Robert Manning, Boston.
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Springfield Amateur,	Springfield,	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
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Farmers' and Mechanics' Associations.

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Leominster,	Leominster,	George M. Kendall, Leominster.	C. C. Foster, Leominster.
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Oakham,	Oakham,	Henry S. Crawford, Oakham.	Wm. S. Crawford, Oakham.
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Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
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Shirley,	Shirley,	H. S. Hazen, Shirley.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.
Wilmington,	Wilmington,	Chas. J. Sargent, Wilmington.	Edw. M. Nichols, Wilmington.

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Chamberlain District,	Worcester,	Wm. J. Wheeler, Worcester.	Pliny Moore, Worcester.
East Charlemont,	East Charlemont,	L. H. Richmond, Shelburne Falls.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	Edward S. Cook, Franklin.	L. W. Daniels, Franklin.
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Rehoboth,	Rehoboth,	Dr. C. H. Raymond, Rehoboth.	C. W. Goff, South Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Royalston,	Royalston,	- -	G. E. Pierce, Royalston.
Rutland,	Rutland,	Wm. C. Temple, Rutland.	Mrs. W. G. Wales, Rutland.
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Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	Henry M. Bliss, Wilbraham.

Miscellaneous.

Agricultural Library Association,	Swansea,	S. G. Arnold, Swansea Village.	A. E. Arnold, Swansea Centre.
Boston Market Gardeners' Association,	Boston and vicinity,	W. W. Rawson, Arlington.	J. B. Shurtleff, Jr., Revere.
Bristol Co. Fruit Growers' Association,	Dighton,	J. E. Sears, Dighton.	Wm. P. Eddy, Dighton.
Bay State Agricultural Society,	The State,	- - -	N. I. Bowditch, Framingham.
Brockton Agricultural Society,	Brockton,	Henry W. Robinson, Brockton.	Baalis Sanford, Brockton.
Burlington Agricultural Society,	Burlington,	Fernald E. Hamm, Lexington.	Samuel Sewall, Burlington.
Cranberry Growers' Association,	Cape Cod District,	Emulous Small, Harwichport.	Franklin Crocker, Hyannis.
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Hampden Agricultural Society,	Springfield,	C. W. Bemis, Longmeadow.	E. S. Batchelder, Springfield.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	W. H. Porter, Agawam.
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Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	J. Woodward Manning, Boston.
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Lecturer,	George S. Ladd of Sturbridge.
Steward,	W. B. Barton of Dalton.
Assistant Steward,	J. B. Parkin of Holliston.
Chaplain,	Rev. C. S. Walker of Amherst.
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Secretary,	Wm. N. Howard of South Easton.
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T. E. Flarity,	Townsend.
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F. H. Stevens,	West Acton.
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Lee, No. 88,	Charles O. Swift, Lee.	Mrs. C. H. Shaylor, Lee.	Mrs. H. J. Voght, Lee.
Charlton, No. 92,	L. C. Prindle, Charlton City.	Miss Alice L. King, Southbridge.	Mrs. Rosa E. Bowers, Charlton Depot.
Grafton, No. 93,	J. Frank Johnson, North Grafton.	Mrs. Emory Harrington, North Grafton.	Miss Lulu E. Whitney, Grafton.

Petersham, No. 95,	Josiah C. Amidon, Petersham.	Mrs. Mary E. Prouty, Petersham.	Mrs. F. M. Spooner, Petersham.
Shrewsbury, No. 101,	Fred J. Reed, Shrewsbury.	Mrs. Jeremy L. Stone, Shrewsbury.	Mrs. Anne S. Rice, Shrewsbury.
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"Garfield" of No. Dana, No. 104,	E. A. Albee, North Dana.	Lyman Randall, North Dana.	Mrs. Lena M. Randall, North Dana.
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West Boylston, No. 106,	Mrs. Jas. H. Robbins, West Boylston.	Miss Louise E. Smith, West Boylston.	Miss Hattie L. Goodale, West Boylston.
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Framingham, No. 113,	George E. Fay, Framingham.	Mrs. L. M. Marston, Framingham.	Harry B. Walkup, Framingham.
Medfield, No. 114,	A. L. Allen, Medfield.	Will T. Herrick, Medfield.	Mrs. W. W. Preston, Medfield.
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Northborough, No. 119,	Elwyn H. Bemis, Northborough.	Clarence E. Buckley, Northborough.	Miss Emma E. Cutler, Northborough.
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MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Norfolk, No. 135,	Austin E. Green, City Mills.	Miss Mabel F. Sims, Norfolk.	Mrs. Rose F. Green, City Mills.
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Haverhill, No. 154,	Isaiah J. Webster, Haverhill.	Miss Susie A. Eastman, Haverhill.	Miss Elmina C. Gordon, Haverhill.
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New Braintree, No. 170,	Harry D. Pollard, New Braintree.	Miss Belle B. Sage, North Brookfield.	Mrs. Horatio Moore, New Braintree.
Merrimac, No. 171,	Arthur P. Ordway, Merrimac.	Mrs. Hattie M. Murphy, Merrimac.	John J. Woodman, Merrimac.
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Ludlow, No. 179,	Chas. B. Bennett, Ludlow.	Mrs. Bertha Taylor, Granby.	Mrs. L. C. Chapman, Indian Orchard.
West Brookfield, No. 180,	Fred G. Smith, West Brookfield.	Dr. W. R. Smith, West Brookfield.	Mrs. Lillian E. Converse, West Brookfield.
Westport, No. 181,	Clarence R. Macomber, Central Village.	Mrs. Sadie B. Wood, Central Village.	James H. Sullivan, North Westport.
Southbridge, No. 182,	Wm. H. Eccleston, Southbridge.	Arthur P. Austin, Southbridge.	Miss Adella Hare, Southbridge.
Andover, No. 183,	Fred M. Hill, Andover.	Ira B. Hill, Andover.	E. W. Burt, Andover.
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"Satuit" of Norwell, No. 187,	J. Warren Foster, Norwell.	Geo. W. Griggs, Norwell.	Miss Lilla M. Smith, Norwell.
Littleton, No. 188,	George H. Cash, Littleton.	Augusta W. Smith, Littleton Common.	B. C. Boyd, Littleton Centre.
Warren, No. 189,	Herbert N. Shepard, Warren.	Alfred A. Warriner, Warren.	Mrs. Jennie M. Williams, Warren.
Bellingham, No. 190,	C. E. White, Bellingham.	Miss M. A. Billings, Bellingham.	W. P. Greenwood, Bellingham.

Massachusetts Patrons of Husbandry — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
"Chestnut Hill" of Blackstone, No. 191,	Justin F. Southwick, Millville.	Miss Ruth L. Southwick, Mendon.	Mrs. Laura V. Dewolfe, Mendon.
Winchendon, No. 192,	Clarence A. Brooks, Winchendon.	Herbert O. Smith, Winchendon.	Mrs. E. A. Capron, Winchendon.
Foxborough, No. 193,	Louis W. Hodges, Foxborough.	Archie H. Dean, Foxborough.	Miss Adella O. Drake, Foxborough.
Townsend, No. 194,	F. S. Palfreyman, Townsend.	T. E. Flarity, Townsend.	G. A. Wilder, Townsend.
Royalston, No. 195,	Luther E. Stewart, Athol.	Ellen Stockwell, Winchendon.	C. A. Stimson, Athol.
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"Brookville" of Holbrook, No. 197,	Fred C. Hollis, Brookville.	Mrs. E. Maud Leonard, Brockton.	E. A. G. Hambly, Brockton.
Leominster, No. 198,	S. R. Walker, North Leominster.	James Coleman, North Leominster.	John E. Ward, Leominster.
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Uxbridge, No. 200,	Wm. H. Thom, Uxbridge.	Mrs. Emma J. Taft, Uxbridge.	Mrs. W. H. Thom, Uxbridge.
Bridgewater, No. 201,	Ernest Leach, Bridgewater.	Mrs. Minnie S. Swift, Bridgewater.	Lucius C. Wood, Bridgewater.
Ashburnham, No. 202,	Nathan T. Wheeler, Ashburnham.	Mrs. Ella C. Needham, Ashburnham.	Miss Lilla S. Litch, Ashburnham.
Westminster, No. 203,	John Minott, South Gardner.	Mrs. Alice W. Sterlin, Westminster.	Mrs. Nellie Waterhouse, Westminster.
Rowley, No. 204,	John D. Bradstreet, Rowley.	Mrs. Abbie F. Ellsworth, Rowley.	John A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Water E. Damon, Marshfield Hills.	Edgar L. Willard, Marshfield Hills.	Mrs. A. L. Carver, Marshfield Hills.
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THIRTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1901.

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1901.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

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HENRY L. CRANE, B.Sc., ...	*Assistant Horticulturist.*
CHARLES L. RICE, ...	*Observer.*

The co-operation and assistance of farmers, fruit growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

The following bulletins are still in stock and can be furnished on demand: —

No. 27. Tuberculosis in college herd; tuberculin in diagnosis; bovine rabies; poisoning by nitrate of soda.
No. 33. Glossary of fodder terms.
No. 35. Agricultural value of bone meal.
No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 43. Effects of electricity on germination of seeds.
No. 47. Field experiments with tobacco.
No. 54. Fertilizer analyses.
No. 55. Nematode worms.
No. 57. Fertilizer analyses.
No. 58. Manurial requirements of crops.
No. 59. Fertilizer analyses.
No. 61. The asparagus rust in Massachusetts.
No. 63. Fertilizer analyses.
No. 64. Analyses of concentrated feed stuffs.
No. 66. Variety tests of fruits; fertilizers for fruits; thinning fruits, pruning; spraying calendar.
No. 67. Grass thrips; treatment for thrips in greenhouses.
No. 68. Fertilizer analyses.
No. 69. Rotting of greenhouse lettuce.
No. 70. Fertilizer analyses.
Special bulletin, — The brown-tail moth.
Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Index, 1888–95.

Of the other bulletins, a few copies remain, which can be supplied only to complete sets for libraries.

Of the numerous problems presented for solution, a few only of the more important have been selected. From a series of experiments on the effect of food on the composition of milk and butter fat and on the consistency or body of butter, it was found: (*a*) that different amounts of protein do not seem to have any influence on the composition of milk; (*b*) that, in general, feeds containing much oil have a tendency to slightly increase the fat content of milk when first fed, but after a few weeks the fat percentage gradually returns to normal; (*c*) that it is not practicable to feed large amounts of oil to cows, as it has a tendency to derange the

digestive and milk-secreting organs; (*d*) that linseed oil effected a noticeable change in the composition of the butter fat, causing a decrease in the volatile acids and an increase in the melting point and iodine coefficient; (*e*) and that cotton-seed meal produced butter fat quite similar in composition to that produced by the standard ration.

In experiments to show the feeding value of barnyard millet, it is shown: (*a*) that the millet has less nutritive value than corn, for the reason that it must be cut when in early blossom to secure it in the most desirable condition for feeding, while the corn can partially mature its grain and still be readily eaten by animals; (*b*) that it is not suitable for hay and is inferior to maize as a silage crop; (*c*) that it furnishes quite a desirable green feed, especially during the month of August, and for this purpose can be most satisfactorily utilized.

A study of the effects of different chemical solutions on germination brought out some interesting facts. The solutions formed from those substances known to exist in seeds and seedlings were of two kinds: ferments, as diastase and pepsin; and amides, as asparagin and leucin. In each experiment one hundred seeds were used, the solution varying in strength from one-tenth per cent. to two per cent. The seeds were soaked in the solution for twelve hours, then rinsed in water and placed in Zurich germinators. With asparagin as the solution on such seeds as vetch, rape, alfalfa, the average percentage of germination for normals was seventy-four and five-tenths per cent.; for the treated was eighty-eight and eight-tenths per cent. and an acceleration of germination in several seeds. With leucin on buckwheat and alfalfa the average of three experiments gave eighty-three per cent. for normal and ninety-two per cent. for treated. With pepsin and diastase there was in like manner a gain of about ten per cent.

Great complaint having been made of the difficulty of growing asters, fifteen thousand were grown under different conditions of fertilizers, varieties, localities, time of planting and methods of handling. A peculiar and obscure disease was made out, not resulting from organisms of any kind,

but very destructive in its effects. There was an abnormal development, due to disturbance of the assimilative functions of the plant.

Remedies for the various diseases of lettuce grown under glass have occupied the attention of the division of plant pathology for several years. The "drop," which is characterized by rotting of the stem and sudden and complete collapse of the whole plant, is the most destructive of these diseases. The amount of loss is very commonly twenty-five per cent. of the entire crop. It has been found that by sterilizing the soil, either wholly or in part, the drop and its kindred disease can be wholly eradicated or suppressed. Experiment shows that five-eighths inch or three-fourths inch surface covering of sterilized sand or earth gave an average reduction of forty-seven per cent. in the amount of drop; one inch of sterilized sand or earth gave an average reduction of eighty-seven per cent.; one inch and a half of sterilized soil, an average of ninety-three per cent.; and two, three and four inches secured entire immunity from the disease.

In the entomological division the structure and life history of various insect pests have been worked out and published, and the remedies to be employed. Among those thus treated are the grass thrips; the thrips of the greenhouse, attacking cucumbers; the fall canker worm; the marguerite fly; and greenhouse aleurodes, doing great damage to tomatoes and cucumbers grown under glass. The San José scale continues its ravages in the State. It has already been found in thirty-seven different towns, and it probably exists in as many more. It attacks the fruit as well as the bark, and specimens of currants, pears and apples have been sent in so completely covered with them as to render their sale impossible.

In the agricultural division the results of experiments continued since 1890 with oats, rye, soy beans, clover and potatoes seem to indicate that the various manures supplying nitrogen rank in the following order: (*a*) nitrate of soda, barnyard manure, sulfate of ammonia and dried blood; (*b*) that in crops of the clover family as nitrogen gathers, the crops not being turned under, but improvement sought from

roots and stubble, there was no appreciable improvement from soy beans, but marked from clover; (*c*) that potatoes, clovers, cabbages and soy beans did much the best on sulfate of potash, while the yield of corn, grasses, oats, barley, vetches and sugar beets has been equally good on the muriate; (*d*) that, if the muriate is used continuously, sooner or later lime must be applied; (*e*) that, with garden crops, both early and late, the sulfate rather than the muriate should be used; (*f*) that none of the natural phosphates appear to be suited to crops belonging to the turnip and cabbage family; (*g*) that, while it is possible to procure profitable crops of most kinds by a liberal use of natural phosphates, the best practice will probably be found to consist in using one of those in part, and in connection with it a moderate quantity of one of the dissolved phosphates.

A detailed account of the operations of the year is herewith submitted.

ANNUAL REPORT

OF GEORGE F. MILLS, *Treasurer* OF THE HATCH EXPERIMENT STATION OF MASSACHUSETTS AGRICULTURAL COLLEGE,

For the Year ending June 30, 1900.

Cash received from United States treasurer,		$15,000 00
Cash paid for salaries,	$5,614 58	
for labor,	4,278 90	
for publications,	409 40	
for postage and stationery,	228 53	
for freight and express,	127 48	
for heat, light and water,	254 96	
for chemical supplies,	108 53	
for seeds, plants and sundry supplies,	602 04	
for fertilizers,	1,168 55	
for feeding stuffs,	136 62	
for library,	157 31	
for tools, implements and machinery,	673 63	
for furniture and fixtures,	51 90	
for scientific apparatus,	384 95	
for live stock,	60 30	
for travelling expenses,	22 02	
for contingent expenses,	125 25	
for buildings and repairs,	595 05	
		$15,000 00
Cash received from State treasurer,	$11,200 00	
from fertilizer fees,	3,600 00	
from farm products,	1,720 86	
from miscellaneous sources,	1,979 82	
		$18,500 68
Cash paid for salaries,	$8,158 11	
for labor,	4,696 81	
for publications,	556 56	
for postage and stationery,	313 85	
for freight and express,	123 64	
Amount carried forward,	$13,848 97	

Amount brought forward,	$13,848 97	
Cash paid for heat, light and water,	582 04	
for chemical supplies,	525 14	
for seeds, plants and sundry supplies,	611 53	
for fertilizers,	162 47	
for feeding stuffs,	995 78	
for library,	96 95	
for tools, implements and machinery,	107 81	
for furniture and fixtures,	50 73	
for scientific apparatus,	546 38	
for live stock,	125 66	
for travelling expenses,	216 62	
for contingent expenses,	94 00	
for buildings and repairs,	536 60	
		$18,500 68

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ending June 30, 1900; that I have found the books well kept and the accounts correctly classified as above; and that the receipts for the year are shown to be $33,500.68 and the corresponding disbursements $33,500.68. All the proper vouchers are on file. These have been examined by me and have been found to be correct, there being no balance on accounts of the fiscal year ending June 30, 1900.

CHARLES A. GLEASON,
Auditor.

AMHERST, Aug. 9, 1900.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Assistants: E. B. HOLLAND, F. W. MOSSMAN,* B. K. JONES,† P. H. SMITH, JR., J. W. KELLOGG.

PART I. — LABORATORY WORK.

Outline of Year's Work.

PART II. — FEEDING EXPERIMENTS AND DAIRY STUDIES.

A. Effect of feed on the composition of milk, butter fat, and on the consistency or body of butter.

B. The feeding value of barnyard millet.

C. Dried distillery grains.

D. Digestion experiments with sheep.

E. The composition of purslane.

F. Parsons' "six-dollar" feed.

* Resigned Nov. 1, 1900.

† Resigned Nov. 1, 1900, to accept position in the Utah Experiment Station.

Part I.

LABORATORY WORK.

Extent of Chemical Work.

The work of the chemical laboratory connected with this department has materially increased over all previous years. There have been sent in for examination 287 samples of water, 123 of milk, 888 of cream, 20 of pure and process butter, 29 of oleomargarine, 123 of feed stuffs and 10 of vinegar. In connection with experiments by this and other divisions of the station, there have been analyzed 45 samples of milk and cream, 60 of butter and 695 of fodders and feed stuffs.

In addition to the above, 707 samples of commercial concentrated feed stuffs have been collected under the provision of the feed law, and tested, either individually or in composite; and 40 tonics, condimental feeds, etc., have been examined. This makes a total of 3,036 substances analyzed during the year, as against 2,045 last year and 1,875 in the previous year.

Character of Chemical Work.

Water, Milk, Cream, Feed Stuffs, etc., sent for Examination. — More than the usual number of samples have been received during the year. Sanitary examinations of water have been carried on as in previous years, according to the Wanklyn process, to determine its general fitness for domestic purposes and for live stock. In milk analysis, the percentages of total solids and fat are the usual ones

determined. The percentage of fat only is determined in cream, unless the quantity of other ingredients is requested. An estimation of the percentage of protein is usually all that is necessary to determine the genuineness of a feed stuff. In some cases it is wise to determine the percentage of fat; in others, the percentage of ash and fibre.

Full information concerning water, milk and cream, how to take samples, etc., will be found in our report for 1899. Special information will be furnished upon application.

Cattle Feed Inspection. — We have continued the inspection of concentrated feeds during the year, collecting and analyzing over 700 samples. A bulletin is about to be issued, giving the results of the work accomplished. The better class of feeds is practically free from adulteration. Some manufacturers and jobbers are still disposed to put cotton-seed meal mixed with ground hulls upon the market, marked simply cotton-seed meal. Mixed feed, so called, consisting principally of wheat bran together with several hundred pounds of fine or flour middlings to the ton, is beginning to be adulterated with wheat hulls, ground corn cobs, etc. This material ought to be accompanied by a guaranty to assure the purchaser of its purity. Many very inferior oat feeds, containing 50 to 60 per cent. of oat hulls, are still on sale. They are very expensive at the price asked for them. These inferior oat feeds are often used by millers to mix with cracked corn, the resulting product being sold as provender. It is quite inferior to a mixture of genuine ground oats and corn. New feeds are constantly coming into the market, most of them by-products from different industries. The writer is convinced that the time is nearly at hand for a change in the present feed law, making it conform to the laws in the other New England States.

Methods of Analysis. — This department has co-operated with the Association of Official Agricultural Chemists in investigating different methods of analysis, with a view to their improvement. During the present year investigations have been made relative to the best methods of determining starch, pentosans and galactan in feed materials, and of casein and albumin in milk. Work of this character cannot

be expressed in figures. It consumes much time, but is very necessary, and likely to be productive of valuable results.

Chemical and Physiological Investigations. — So far as time and resources permit, the chemical staff is engaged in investigating some of the many pressing dairy and feeding problems. The time at present is largely devoted to the examination of butter fat, the manufacture of butter and to the digestibility of feeding stuffs. It is to be regretted that the analysis of the various materials sent to the station — waters, milk, cream, butter and feed stuffs — consumes each year an increasing amount of time, and necessarily limits the extent of experimental work.

PART II.

FEEDING EXPERIMENTS AND DAIRY STUDIES.

A.—EFFECT OF FEED ON THE COMPOSITION OF MILK, BUTTER FAT, AND ON THE CONSISTENCY OR BODY OF BUTTER.

J. B. LINDSEY.*

CONCLUSIONS.

As a result of the experiments which follow, concerning the influence of feeds and feed constituents on the composition of milk, butter fat, and on the character of the butter, the following deductions are made: —

1. Different amounts of protein do not seem to have any influence on the composition of the milk.

2. Linseed oil in flax-seed meal, when fed in considerable quantities (1.40 pounds digestible oil daily), increased the fat percentage and decreased the nitrogenous matter of the milk. This fat increase was only temporary, the milk gradually returning (in four or five weeks) to its normal fat content. The nitrogenous matter also gradually returned to normal, but more slowly than the fat.

3. In general, feeds containing much oil have a tendency to slightly increase the fat content of milk when first fed. The fat percentage gradually returns to normal.

4. It is not practicable to feed large amounts of oil to cows, as it has a tendency to derange the digestive and milk-secreting organs.

* Ably assisted by E. B. Holland, F. W. Mossman, B. K. Jones and P. H. Smith, Jr.

5. Linseed oil effected a noticeable change in the composition of the butter fat, causing a decrease in the volatile acids and an increase in the melting point and iodine coefficient.

6. All oils do not produce the same effects on butter fat.

7. The melting point of butter fat is not always indicative of the firmness or body of butter.

8. An excess of linseed oil produced a soft, salvy butter, with an inferior flavor.

9. Linseed and corn gluten meals, with a minimum percentage of oil (3 per cent.), produced a normal butter fat. The corn gluten meal produced butter with a desirable flavor and of good body.

10. King gluten meal (corn gluten meal with 13 per cent. oil) increased the iodine coefficient of the butter fat several degrees above standard ration butter fat, and slightly depressed the melting point of the fat. This effect was probably due to the corn oil. The same meal produced butter of a very desirable flavor and body.*

11. Cotton-seed meal produced butter fat quite similar in composition to that produced by the standard ration. The butter produced by this meal was rather crumbly when hard, and slightly salvy to the taste.

Further experiments concerning the effects of food and food constituents on butter fat and butter are now in progress.

(*a*) Preliminary Statement.

During the last six years a number of experiments have been made at this station relative to the effect of food, first on the composition of milk and later on the composition of butter fat. It is not the writer's intention at this time to attempt any historical or critical review of the work of others along these lines, nor to present the full data of his own work, but rather to call attention to the progress thus far made in the effort to secure positive knowledge on the subject under investigation. The detailed experiments will be published at a proper time. The writer believes that experimenters have hitherto neglected to note the effect of the several food

* The body of this butter was very satisfactory to Mr. W. A. Gude, the scorer, but might have been considered by some as lacking in firmness.

constituents — protein, fat and carbohydrates — on the milk and butter fat, but have rather attempted to observe the influence of the combinations of these groups as they exist in the different foods. It is believed that the former method would yield more definite information on this perplexing subject.

(*b*) The Effect of Protein on the Composition of Milk.

In an early experiment * different amounts of protein were fed, and the effect on the composition of the milk was noted. The experiment showed that the fat content of the milk appeared to be increased. Unfortunately, the ration contained, in addition to the protein, an excess of corn and cotton-seed oil, derived from gluten feed and cotton-seed meal, and it was not at all clear whether the protein or the oil was responsible for the fat increase. Again, the periods were of too short duration to make clear whether the increase was temporary or permanent. In the next two experiments† the oil factor was eliminated as far as possible, the protein being derived from corn and gluten meals. The length of the periods were increased so as to cover from four to six weeks, and, because of increased facilities for carrying out the experiments, many outside influences bearing upon the results were eliminated. The results of these two investigations showed no particular influence of the protein upon the several ingredients of the milk, except a very slight increase in the nitrogenous matter of the milk when the largest amount of protein was fed. It therefore seemed probable that the oil in the rations fed in the first experiment above referred to was responsible for the fat increase.

(*c*) The Effect of Fat on the Composition of Milk.

About this time (1898), Soxhlet, a German investigator, made the statement that, contrary to general teachings, the fat of the food — as found in the different oil cakes fed on the continent — did produce a very noticeable increase in the

* Report of Massachusetts State Experiment Station, 1894.
† Ninth and eleventh reports of Hatch Experiment Station.

relative amount of fat in the milk. The full data proving this statement has not been published. The conclusion of several American experimenters who had previously fed different fats to dairy animals was that no positive increase was to be observed. Soxhlet suggested that the reason the effect of "food fat" had not been more pronounced was because the fat or oil fed had not been digested and assimilated by the animals. Following out the suggestion made by our first experiment, and endeavoring to prove or disprove Soxhlet's statements, several experiments were instituted.

The first two were made with three animals, — the only ones in condition at the time, — in the summer of 1898, and have been designated Experiments I. and II. It was merely a preliminary test. These animals were in rather an advanced stage of lactation, but producing 15 to 20 pounds of milk each per day. The coarse feeds during the several periods consisted of first and second cut hay, or second cut hay and green feed. The grain feed during the "normal oil" periods was wheat bran, or bran and Chicago gluten meal; and in the so-called "excess oil" periods flaxseed meal* was added to the wheat bran, or was substituted for the Chicago gluten meal. In the normal oil periods the amount of oil calculated to be digested was from .4 to .5 pounds, and during the excess oil periods from 1.4 to 1.8 pounds. The normal oil periods lasted seven days, then followed excess oil period of ten days, subsequently normal oil periods of four days. Each period proper was preceded by a preliminary period of seven days. When the excess oil was fed, the fat of the milk increased one-half per cent. in almost every case (that is, from 5 to 5.50, for example), and in some cases even more, and dropped back again when the excess oil was removed to even below what it was in the first or normal oil period. Part of the increase might be attributed to change of feed. The periods were short and the weather warm, and the experiment could be considered of only sufficient importance to warrant still further investigations under more favorable conditions.

* This meal contained about 37 per cent. of linseed oil.

Experiment III.

[New-process linseed meal (Cleveland flax meal) *v.* flaxseed meal.]

The next experiment was begun in October, 1898, and continued until February, 1899. The cows, ten in number, were divided as evenly as possible into Herds I. and II. Both herds received rowen (second cut hay) as the coarse fodder during the entire experiment. The grain ration for each herd consisted of bran, new-process linseed meal* (Cleveland flax meal, so called) and corn meal during the first period of three weeks, one week of which was preliminary. This was designated the "normal oil" ration. In the second period of twelve weeks Herd II. received flaxseed meal in place of the Cleveland flax meal, and corn meal; and the entire ration of Herd I. was continued unchanged. The ration consumed by Herd II. in the second period was designated the "excess oil" ration. The third period proper lasted two weeks, and both herds were fed the same ration as in the first period. Herd I. then received the same (normal oil) ration throughout the entire experiment and Herd II. the excess oil ration in the second period. The normal oil ration consisted of about .5 pounds of digestible oil and the excess oil ration of 1.75 pounds. The amount of protein and carbohydrates were essentially the same, the oil being the varying factor.

Daily Ration (Pounds).

HERDS.	Wheat Bran.	Cleveland Flax Meal.	Flaxseed Meal.	Corn Meal.	Rowen.
First period: both herds normal oil ration.					
Herd I.,	2	2	-	2 to 3	20 to 24
Herd II.,	2	2	-	2 to 3	20 to 24
Second period: Herd I., normal oil ration; Herd II., excess oil ration.					
Herd I.,	2	2	-	2 to 3	20 to 24
Herd II.,	2	-	4	0 to 1	20 to 24
Third period: both herds normal oil ration.					
Herd I.,	2	2	-	2 to 3	20 to 24
Herd II.,	2	2	-	2 to 3	20 to 24

* This meal contained less than 3 per cent. of oil.

The animals completed the experiment with only slight disturbances. Composite samples of each cow's milk and of the mixed milk of each herd were made for five days of each week, and the milk was tested for total solids, fat, nitrogen and ash. The analyses of the mixed milk only are presented at this time: —

Milk Analyses.

First period: both herds normal oil ration.

SAMPLES.	Total Solids.		Fat.		Solids not Fat.		Nitrogen.		Ash.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
Weekly sample,	13.27	13.25	4.23	4.05	9.04	9.20	0.519	0.531	0.69	0.72
Weekly sample,	13.55	13.43	4.62	4.40	8.93	9.03	0.539	0.543	0.70	0.71
Weekly sample,	13.79	13.62	4.59	4.52	9.20	9.10	0.547	0.544	0.72	0.72
Averages, .	13.54	13.43	4.48	4.32	9.06	9.11	0.535	0.539	0.70	0.72

Second period: Herd I., normal oil ration; Herd II., excess oil ration.

Weekly sample,	14.00	14.36	5.07	5.56	8.93	8.80	0.550	0.511	0.71	0.72
Weekly sample,	14.12	-	5.05	-	9.07	-	0.581	-	0.71	-
Weekly sample,	14.16	14.25	4.96	5.24	9.20	9.01	0.572	0.529	0.72	0.71
Weekly sample,	14.21	14.19	5.16	5.27	9.05	8.92	0.574	0.532	0.73	0.71
Weekly sample,	14.26	14.02	5.08	5.14	9.18	8.88	-	-	-	-
Weekly sample,	14.21	14.03	5.13	5.19	9.08	8.84	0.575	0.519	0.72	0.71
Weekly sample,	14.07	13.85	4.85	4.96	9.22	8.89	0.575	0.517	0.72	0.70
Weekly sample,	14.07	13.92	4.85	5.00	9.22	8.92	0.572	0.531	0.72	-
Weekly sample,	-	13.96	-	5.05	-	8.91	-	-	-	-
Weekly sample,	14.30	14.06	4.85	4.93	9.45	9.13	0.587	0.536	0.72	0.71
Averages, .	14.16	14.07	5.00	5.15	9.16	8.92	0.573	0.525	0.72	0.71

Third period: both herds normal oil ration.

Weekly sample,	14.14	13.54	4.87	4.38	9.27	9.16	-	0.561	-	0.70
Weekly sample,	14.06	13.70	4.68	4.28	9.38	9.42	-	0.566	-	0.71
Averages, .	14.10	13.62	4.77	4.33	9.33	9.29	-	0.563	-	0.71

In studying the *average results*, one notes that in the first period both herds produced milk of approximately the same quality. The second period of twelve weeks showed an increase in the fat of Herd I. from 4.48 to 5, or .52 per cent.,

— a natural increase, due to the advance in the period of lactation; and in Herd II. from 4.32 to 5.15, or .83 per cent. The percentage increase in Herd I. was 11.6 per cent. and in Herd II. 19.2, showing that Herd II. made the greater average increase. The total solids increased about the same in each herd. The average nitrogen percentage increased for Herd I. from .535 to .573, in about the same proportion as the total solids; while Herd II., instead of showing an increase, had a slight decrease. The ash remained practically unchanged. In the third period there was a slight decrease in the total solids and fat of Herd I., and a very noticeable decrease in the fat of Herd II. The nitrogen percentage of Herd II. in this period increases to about the average produced by Herd I. in the second period. To note, however, the full effect of the excess oil ration, one must observe the weekly analyses of the milk of both herds in the excess oil period. For example, the last fat test in the normal oil period was 4.59 per cent. for Herd I. and 4.52 per cent. for Herd II. The first fat test in the second period was 5.07 for Herd I. (receiving the normal oil ration) and 5.56 for Herd II. (receiving the excess oil ration). During this entire period Herd I. showed little variation in fat, and averaged 5 per cent. Herd II. increased from 4.48 to 5.56 at the beginning of the excess oil period, and then gradually decreased, until at the close of the period it tested 4.93 and averaged 5.15 per cent. of fat. When it is remembered that the figures given represent the mixed milk of five cows, it seems safe to conclude that the excess of oil did increase the percentage of fat in the milk, but the increase was only temporary, the fat percentage gradually dropping back to an amount parallel with Herd I. The nitrogen percentage of Herd II. in the second period did not increase so rapidly as did the fat. At the beginning of the period it was less than at the close of Period I., and did not begin to increase until near the close of the period. In the third period it was apparently normal again.

One might suppose that the fat increase in the case of Herd II. could be accounted for by the shrinkage in milk production. The shrinkage, however, was no more than

with Herd I. Again, should this be the case, why should not the nitrogen increase in the same proportion, instead of actually decreasing, etc.?

To summarize briefly, the marked effect of the oil was to produce a quite noticeable increase in the percentage of milk fat when first fed; this increase gradually diminished, until at the end of the fifth week it reached the normal.* When the excess oil ration was removed, the milk fat percentage dropped noticeably below the normal. A second effect of the oil ration was to cause a depression in the percentage of nitrogen in the milk, which began to increase only towards the close of the period, and increased to the normal percentage when the excess oil ceased to be fed. As a result of this experiment, one is led to inquire in what way the oil in the feed caused the temporary increase of fat in the milk. Does the *feed oil* to any extent enter directly into the milk fat, or does it by substitution cause the body fat to be utilized by the animal in the production of milk fat, as Soxhlet suggests; or does the feed oil produce a disturbance in the milk glands, causing an increased fat secretion, by utilizing a portion of the material that would otherwise become nitrogenous matter and milk sugar? These are questions worthy of further investigation.

This experiment is rather more decisive in its teachings than many earlier investigations. The question for further investigation is, whether other oils, derived from cotton-seed, corn, etc., act in a similar way to linseed oil. Investigations touching this and other points are now in progress.†

(*d*) The Effect of Linseed Oil on Butter Fat.

Two samples of butter fat were taken weekly from each herd, in the experiment above described, and upon analyses yielded the following *average* results: —

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* By normal is meant the percentage produced by Herd I.

† This experiment was completed during the winter of 1898–99, but has remained unpublished, owing to the prolonged illness of the writer. Since that time Hills (twelfth report, Vermont Experiment Station), Rhodin (Milch Zeitung 27, pp. 306-323, 1898), Bartlett (fourteenth report, Maine Experiment Station) and others have published results of a similar nature, to which more extended reference will be made at another time.

Butter Fat Analyses.

First period: both herds normal oil ration.

HERDS.	Length of Period (Weeks).	Specific Gravity $(\frac{100}{100})$.	Reichert-Meissl Number.	Butyric Acid Equivalent.	Melting Point (Degrees C.).	Iodine Number.
Herd I., . . .	2	.905	29.79	5.24	31.99	28.93
Herd II., . . .	2	.906	28.62	5.04	32.24	30.02
Second period: Herd II., excess oil ration.						
Herd I., . . .	12	.904	30.28	5.33	32.89	28.16
Herd II., . . .	12	.903	25.17	4.43	36.93	43.19
Third period: both herds normal oil ration.						
Herd I., . . .	2	-	-	-	-	-
Herd II., . . .	2	-	27.96	4.92	33.03	32.15

The averages show that the effect of the oil was to depress the volatile acids and to increase the melting point and iodine number. The change was noted in the case of Herd II. at the beginning of the excess oil period, and continued uninterrupted until its close.

In the third period of two weeks (one week preliminary and two weeks proper), in which both herds received the normal oil ration, the butter fat in case of Herd II. changed in composition nearly to that of Herd I. at the close of the second period. The effect of the change of feed was observed at the close of the first week, but it seemed to require several weeks for the animals to thoroughly readjust themselves. It is evident that the linseed oil caused a butter fat to be produced having lower volatile acids than that produced in the normal oil period. One would also assume that it caused a change in the relative proportions of stearin, palmitin and olein. The question arose as to whether linolic and linolinic acids — the characteristic acids of linseed oil — had been actually transmitted to the butter fat, and an effort was made to detect them, but without positive results. We hope to still further investigate this matter.

(e) The Effect of Linseed Oil on Butter.

When this experiment was begun it was not the intention to convert the cream into butter, but to note particularly the effect of the oil on the composition of the milk and butter fat. The oil, however, effected such a change in the chemical character of the butter fat that it seemed wise to note its effect on the resulting butter product. Accordingly six lots of butter were made from each herd, towards the close of the second or excess oil period. It was not possible at the time to make a first-class article, owing to poor facilities. We were obliged to ripen the cream in cans, to churn with a small hand churn and to work the butter with a small paddle.* Two lots of butter from each herd were submitted to chemical analysis, and found to be of normal character. They contained from about 10 to 12 per cent. of water, 85 to 87 per cent. of butter fat, less than 1 per cent. of curd and a normal amount of salt. The several samples were scored by Mr. W. A. Gude, of the firm of Gude Bros., New York, who stated that both lots were of poor flavor, having a burnt taste, as of rendered butter; and the body from Herd I. was short grained, brittle and crumbly; from Herd II., salvy or very salvy.

Mr. C. H. Eckles, butter maker at the college dairy school, reported as follows concerning the body and flavor of the several butters: "The butter from the normal ration is considerably firmer than that from the excess oil ration, and the grain is shorter. As compared with the product of the best creamery butter, neither is exactly normal in consistency, the normal ration butter being more crumbly and the butter from the excess oil ration more salvy or greasy than normal. From a commercial stand-point, the body of excess oil butter is possibly the more objectionable. The flavor and aroma of normal ration butter is inferior to that of excess oil butter. In case of the former, something of an old flavor, impossible to describe, is noticed. The flavor of excess oil butter, while not very good, is more the flavor

* Since then a small dairy building for experimental purposes has been erected and fully equipped for this department.

of fresh butter." Referring to another lot, Mr. Eckles says: "The same difference in consistency was observed, and in about the same degree, and the difference in flavor was the same, but more marked."

The writer lays no claim to being an expert judge of butter, but his observations, made at the time, were as follows: Butters from normal ration were hard and firm at 15° C., and those from excess oil ration of a softer, lardy nature. It required some effort to force a glass rod into normal ration butter, but the same rod slipped much easier into excess oil butter. One could distinguish the two butters almost with the eye, and easily with the touch. Samples of the two butters were placed in crystallization dishes upon a hot-water radiator. Normal ration butter remained firmer for a time than excess oil butter, but resolved itself into oil more quickly. When normal ration butter was nearly all oil, excess oil butter was soft enough to spread out over the bottom of the dish, but had melted but little. This latter observation is very interesting, and shows, at least in case of this experiment, *that the melting point of the butter fat did not govern the firmness or body of the butter.* Does this hold true in all cases? The average melting point of normal oil butter fat was 32.89 and of excess oil butter fat 36.93. While the excess oil butter fat showed a melting point 4° higher than the normal oil fat, yet the normal oil butter was firmer at ordinary temperature, and kept its body better when a gentle heat was applied. When, however, the heat was increased, the firmer normal oil butter actually resolved itself into oil more quickly than did the salvy excess oil butter. The reason for this cannot be discussed at this time.

It is clear, from the foregoing observations, that the butters from both herds were of quite inferior flavor. It was unfortunate that our facilities for butter making at the time were not better. Just why the flavor of both lots was so poor is not quite clear, as they were made by an experienced butter maker, the stable was clean and the milk carefully handled. How much of this is to be attributed to poor facilities, how much to inferior bacteria and how much to influence of food, cannot be ascertained. The butters were

probably rather overworked. One point, however, stands out *very distinctly; namely, the influence of food on the body of the butter.* The linseed oil surely produced a butter of high melting point, yet soft and salvy, and unable to stand up under a gradually rising temperature, as did the butter when the oil was not fed.

The above experiment naturally suggests two questions: First, do the oils in the various feed stuffs tend to produce a salvy butter, lacking in firmness? Second, what is the effect of different forms of protein, as found in linseed, cotton-seed and gluten meals on the body of butter?

(*f*) The Effect of Different Concentrated Feeds on Butter Fat and Butter.

At the close of the above experiment it seemed advisable to note the effect of several concentrated feeds, as they are found in the markets, upon the character of butter fat and butter. Accordingly a "standard" grain ration was adopted, and other rations compared with it. It is not to be inferred that the so-called "standard" ration is superior to all other rations, but simply that it was thought to be a safe and desirable ration, and likely to produce a normal butter.

Two experiments, known as Experiments IV. and V.,* were completed in the spring of 1898, with twelve cows, divided into two herds of six cows each. Rations containing 4 pounds of Cleveland flax meal and 4 pounds of Chicago gluten meal, respectively, were compared with the standard ration. Herd II. received the standard ration, and Herd I. the Cleveland flax meal and Chicago gluten meal rations. All these rations contained only a normal amount (.5 to .6 pounds) of digestible oil, while the Cleveland flax or the Chicago gluten meal themselves contained less than 3 per cent. of oil, so that one could note particularly the effect of the protein in the linseed and gluten meals on the butter fat and butter.

* These two experiments were made in connection with the Department of Agriculture.

Daily Ration (Pounds).

RATIONS.	Wheat Bran.	Ground Oats.	Cotton-seed Meal.	Chicago Gluten Meal.	Cleveland Flax Meal.	First Cut Hay.	Corn Silage.
Standard ration, . .	3	5	.5	.5	-	12-15	20
Cleveland flax meal ration.	2	2	-	-	4	12 15	20
Chicago gluten meal ration.	2	2	-	4	-	12-15	20

The experiments proper lasted five weeks, preceded by a preliminary period of ten to fourteen days.

Experiment IV.

[Standard ration *v.* Cleveland flax meal ration.]

Five samples of butter fat were analyzed, with the following average results : —

Butter Fat Analyses.

RATIONS.	Reichert-Meissl Number.	Butyric Acid Equivalent.	Insoluble Acids.	Melting Point.	Iodine Number.
Standard ration, ...	30.92	5.44	88.48	33.80	28.96
Cleveland flax meal ration, . .	29.50	5.19	88.69	33.23	26.77

The averages show comparatively slight variations, the fats resulting from both rations being normal in character. The Cleveland flax meal ration produced a fat with less volatile acids and a trifle lower melting point and iodine number than did the standard ration. Whether this difference is due to the individuality of the two herds, or to the influence of the linseed meal, cannot be stated.

Ten lots of butter were made from each herd. The ripening, churning, etc., were made in the same way as in the previously described linseed oil experiment (Experiment III.). Five lots of butter made from each ration were analyzed and found to be of normal character. The ten lots were scored by Mr. W. A. Gude of New York, with the following average results : —

Average Butter Score.

	Flavor.	Body.	Color.	Salt.	Style.	Total.
Standard ration,	35.9	24.2	15	10	5	90.1
Cleveland flax meal ration,	31.4	22.0	15	10	5	82.4
Standard score,	45.0	25.0	15	10	5	100.0

Mr. Gude reported the flavor of the butter from the flax meal ration as "stale, rancid or oily," "strong, oily, seems rancid," "oily," etc. Concerning the flavor of standard ration butter he reported "fair to fine" and in four instances he referred to "oily flavor." With regard to body of flax meal butter he used the terms "brittle, dry, salvy, short," and for standard ration butter "good, but trifle short," and "perfect." In a letter Mr. Gude said: "While trying to pay particular attention to body, I notice that the most objectionable feature is that peculiar oily taste," etc. "This I notice you have apparently overcome in No. 1282" (standard ration butter). Again: "I notice a particular improvement in the quality, particularly of samples 1272 and 1274" (standard ration butter).

The butters were rather dry, having about 12 per cent. of water. It is clear that, while the butter made from both rations did not score high, that made from the flax meal ration was noticeably inferior in flavor and in body to the standard ration butter. This seems to agree with the linseed oil experiment (Experiment III.). In that experiment, even when only two pounds of flax meal were fed, the flavor was inferior; and when flax-seed meal was fed the body and flavor were both bad. It is not desired, however, to be too positive about the flax meal (linseed meal, with a minimum amount of oil) producing an inferior-flavored butter, but we prefer to call attention to the results thus far secured, and to repeat the experiment.

Experiment V.

[Standard ration *v.* Chicago gluten meal ration.]

This experiment was identical with Experiment IV., excepting that 4 pounds of the Chicago gluten meal (corn gluten) were substituted for 4 pounds of flax meal. The average results of the analyses of five samples of butter fat follow: —

Butter Fat Analyses.

RATIONS.	Reichert-Meissl Number.	Butyric Acids Equivalent.	Insoluble Acids.	Melting Point.	Iodine Number.
Standard ration, ...	30.07	5.29	88.84	34.76	29.00
Chicago gluten meal ration, . .	32.07	5.64	88.26	33.04	27.67

No wide variations are noted. The Chicago gluten ration produced rather more volatile acids, a trifle less insoluble acids, a lower melting point and a lower iodine number. The differences are too slight to draw any positive conclusions. In both these experiments (Experiments IV. and V.) one notes that the standard ration produced butter with a little higher melting point and a lower iodine number. All the butter fats, however, were of normal character.

Ten lots of butter were made from each ration, under similar conditions, as previously described. Five samples were analyzed chemically and found to be normal. The butter was quite dry, showing but 11 per cent. of water. Mr. Gude scored the ten samples made from each ration with the following average results: —

Average Butter Score.

	Flavor.	Body.	Color.	Salt.	Style.	Total.
Standard ration, ...	35.6	23.8	15	10	5	89.4
Chicago gluten ration, ...	35.2	24.0	15	10	5	89.2
Standard score, ...	45.0	25.0	15	10	5	100.0

These butters appear to be practically identical, no particular feed influence being noted. The first four or five lots

from each ration were reported as having a "tainted off flavor," and were marked down. The last five lots were reported as being "good," "clean flavor," etc., and scored 38 and 39 out of a possible 45. The body of each of the two lots was reported a "trifle short," "brittle," "breaks easily," etc., and were marked down one point. The score is not very high, due to rather poor flavor. This is attributed, partly at least, to rather poor facilities in ripening and handling and not to feed. The corn gluten in this case does not appear to have had any bad influence on the body of the butter. It is held by many that gluten products produce a soft, salvy butter. This we are inclined to attribute to the influence of the corn oil, which is now largely removed before the gluten products are put upon the market. Bartlett's recent experiments support this view.*

Both lots of butter were tested for firmness of body by the usual method of allowing a plunge of given weight to drop from a certain height, noting the degree of penetration in millimeters. The average figures were 6.9 millimeters for the standard ration, and 6.7 millimeters for the Chicago gluten meal ration, showing practically no difference.

Experiment VI. 1899–1900.

[Period I., standard ration, both herds; Period II., standard ration *v.* King gluten meal ration; Period III., standard ration *v.* cotton-seed meal ration.]

During the winter of 1899–1900 another experiment was instituted, to note the effect of King gluten meal, with 14 per cent. corn oil, and normal cotton-seed meal, with 12.6 per cent. oil, on the butter fat and butter. Ten cows were divided as evenly as possible into herds of five each. In the first period, lasting two weeks,† both herds were fed the standard ration. In the second period of five weeks † Herd I. received the standard ration and Herd II. the King gluten meal ration. In the third period of five weeks † Herd I. received the standard ration and Herd II. the cotton-seed meal ration. It will thus be seen that both Herds received the same ration in the first period, then Herd II. was changed

* Maine Experiment Station report, 1898, pp. 97–113.

† Preliminary period of two weeks not included.

to the other two rations and Herd I. was used as a check for comparison. The several rations were as follows: —

Daily Rations (Pounds).

RATIONS.	Wheat Bran.	Ground Oats.	Cotton-seed Meal	Chicago Gluten Meal.	King Gluten Meal.	Corn Silage.	Hay.
Standard ration,	3	5	.5	.5	-	20	10-15
King gluten meal,	2	2	-	-	4	20	10-15
Cotton-seed meal,	2	2	4	-	-	20	10-15

The average results follow: —

Analyses of Butter Fat.

First period: both herds standard ration.

HERDS.	Number Samples.	Saponification Equivalent.	Insoluble Acids.	Reichert-Meissl Number.	Butyric Acid Equivalent.	Melting Point (Degrees C.).	Iodine Number.
Herd I.,	4	233.3	88.35	32.18	5.67	34.08	25.84
Herd II.,	4	232.9	87.98	32.64	5.74	33.94	26.78
Second period: Herd I., standard ration; Herd II., King gluten meal ration.							
Herd I.,	10	232.4	88.27	31.48	5.54	34.00	26.44
Herd II.,	10	231.0	88.24	32.62	5.76	32.80	32.75
Third period: Herd I., standard ration; Herd II., cotton-seed meal ration.							
Herd I.,	10	229.6	88.62	30.56	5.38	34.12	26.35
Herd II.,	10	227.9	88.70	31.03	5.46	35.60	29.35

The experiment began December 7 and ended April 15, or 130 days. It is interesting to note the evenness in the composition of the butter fat during this time produced by Herd I. receiving the standard ration. There was a slight decrease in the saponification equivalent and the Reichert-Meissl number, but practically no change in the melting point or iodine number.

In the first period both herds produced butter fat of similar composition. In the second period the fat produced by Herd II., receiving the King gluten meal ration, showed no

change in Reichert-Meissl number, a slight depression in melting point and a noticeable increase in the iodine number. The effect would probably have been more marked had more corn oil been fed. In the case of the linseed oil experiment both the melting point and iodine number were increased.

In the third period the fat produced by the cotton-seed meal ration showed but little change in composition from that produced by the standard ration.

It seems evident that different oils — linseed, corn and cotton-seed oils — exert a different influence on butter fat, these oils themselves being of different composition.

In making the butter, the creams, raised by the gravity process, were treated as nearly alike as possible. Our dairy building was completed, and afforded excellent facilities for doing the work. The cream was ripened to approximately .7 acidity in forty-eight hours. A skim-milk starter was used without the aid of any specially prepared ferment. Every sample of butter was analyzed and found to be normal, showing about 12 per cent. of water, 80 to 82 per cent. of butter fat and 1 per cent. casein. The butters were scored by Mr. W. A. Gude, with the following average results: —

Average Butter Score.

First period: both herds standard ration.

HERDS.	Number Samples.	Flavor.	Body.	Color.	Salt.	Style.	Total.
Herd I.,	4	36.2	23.4	15	10	5	89.6
Herd II.,	4	36.2	23.4	15	10	5	89.6
Second period: Herd I., standard ration; Herd II., King gluten meal ration.							
Herd I.,	10	37.8	24.0	15	10	5	91.8
Herd II.,	10	39.7	24.9	15	10	5	94.6
Third period: Herd I., standard ration; Herd II., cotton-seed meal ration.							
Herd I.,	10	36.0	24.1	15	10	5	90.1
Herd II.,	10	35.9	24.4	15	10	5	90.3
Standard score,	–	45.0	25.0	15	10	5	100.0

Mr. Gude's notes concerning the different samples are as follows: First period: flavor, "fair aroma," "fairly clean," "oily taste;" body, "short and breaks easily, seems brittle," "slightly short and brittle." Second period: flavor, Herd I., "fairly clean, lacks aroma," "defective;" Herd II., "clean and fine;" body, Herd I., "brittle, short, seems light and spongy, trifle salvy;" Herd II., "all right." Third period: flavor, Herd I., "fairly clean, but lacks aroma," "slight taints;" body, Herd I., "spongy when soft, short and crumbles when hard;" Herd II., "perfect," "short when soft, crumbles when hard," "salvy to taste."

Average Degree of Penetration (Millimeters).

HERDS.	First Period.	Second Period.	Third Period.
Herd I.,	4.8	4.9	5.4
Herd II.,	4.9	6.7	5.8

Our own deductions, based on the score and remarks of Mr. Gude and the degree of penetration concerning this experiment, are as follows: The tendency of the standard ration was to make butter with a firm body and likely to crumble. It seemed also to produce at times a slight oily or defective flavor. The hardness is probably due to the oats, and possibly the oily flavor to the oil of the oats. The King gluten meal seemed to produce a butter very satisfactory to Mr. Gude. He gave it an average score of 94.6, spoke of its flavor as clean and fine and of its body as perfect. The degree of penetration shows it to be a softer, more yielding butter than that produced by the standard ration. This condition is probably brought about by the corn oil. Butters of this consistency are objected to by some. It is our intention soon to feed corn gluten without oil, and the same with different quantities of oil.

The cotton-seed ration produced butter of about the same quality and condition as the standard ration. Mr. Gude spoke of it as lacking aroma and having a slight taint, and of being rather spongy when soft and crumbling when hard. This butter is firmer than the King gluten butter. It would

be of interest to note the influence of the cotton-seed protein and the cotton-seed oil separately on the butter, and we hope to carry out such experiments.

It is clear, from our several experiments, that food does influence to a noticeable degree the composition of the butter fat and the body of the butter. It seems also to influence the flavor; to what extent, as compared with the influence produced by bacteria, is not quite clear. This matter is being given further study.

B. — THE COMPOSITION, DIGESTIBILITY AND FEEDING VALUE OF BARNYARD MILLET (*Panicum crus-galli*).

J. B. LINDSEY.

Conclusions.

1. Barnyard millet is a warm-weather plant, similar in this respect to Indian corn.

2. As harvested in early blossom, the fodder contains less nitrogen-free extract matter, more fibre or woody matter, and rather more ash than corn fodder. The seed resembles the cereals (especially oats) in composition. It contains considerable more fibre, rather more ash and 5 to 6 per cent. less extract matter than maize.

3. Barnyard millet, grown on naturally moist and fertile land, will probably yield as much dry matter per acre as corn.

4. It has less nutritive value than the corn, the principal reason for this being that the corn can partially mature its grain and still be readily eaten by animals, while the millet must be cut when in blossom to secure it in the most desirable condition for feeding.

5. It is not suitable for hay, and, while it makes a fairly satisfactory silage, it is inferior to maize as a silage crop.

6. It furnishes a desirable green feed, especially during the month of August, and *it is for this purpose that it can be most satisfactorily utilized*.

7. The millet can be used for silage in place of corn whenever it is not convenient or possible to grow the latter.

Preliminary Statement.

During the last ten year's the attention of farmers has been frequently called to the value of several varieties of Japanese millets.* Experiments have demonstrated the *Panicum crus-galli* — now termed barnyard millet — to be the most useful Japanese variety for fodder purposes; and this department has endeavored to ascertain, by experiment and observation, its relative value, as compared with other materials of similar character, as a food for dairy animals. The term barnyard millet has been adopted as its common name, for the reason that it appears to be a cultivated and improved variety of the common barnyard grass. The information given below is not meant to be an exhaustive treatise on the subject, but rather a bringing together of data already at hand concerning the nutritive value and practical utility of the plant.

(*a*) Character of the Millet.

This variety of millet is a coarse-growing form, with a comparatively heavy leafage and compact beardless heads. When headed out it stands from four to six feet in height, and rarely lodges. It is a warm-weather plant, similar to corn, and makes a very rapid growth when the temperature is high. Sown the middle of May, it begins to head about August 1, the time varying a little, depending on weather conditions. After the heads appear it becomes woody, and proportionately less valuable for fodder purposes. It will not endure dry weather as well as corn, and succeeds best upon moist land in a good state of fertility. If cut when it begins to bloom, a second crop may be frequently secured, but it is apt to be small in quantity and coarse in quality.

(*b*) Composition of Green Millet.

Numerous analyses of this material have been made, the more recent ones by this department being tabulated as follows: —

* See, in the different reports of the Massachusetts Agricultural College and Hatch Experiment Station, the articles by Prof. W. P. Brooks, to whom we are indebted for the introduction of these fodder plants. See also Farmers' Bulletin, 101, published by the United States Department of Agriculture, on millets.

I. Water-free Material (Per Cent.).

	Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
(*a*) First week of blossom,*	-	7.84	8.44	32.06	49.92	1.74
(*b*) Second week of blossom,*	-	8.59	11.00	35.03	43.65	1.73
(*c*) Well headed,†	-	10.18	10.73	34.48	43.05	1.56
(*d*) Beginning to head,†	-	8.36	6.77	36.69	46.78	1.40
Average,	-	8.74	9.23	34.56	45.85	1.62
Corn fodder for comparison,‡	-	5.20	9.70	21.30	60.60	3.20

* (*a*) and (*b*) grown in same year on same plot.
† (*c*) and (*d*) grown in different years.
‡ Flint varieties, average forty analyses, Jenkins' and Winton's tables.

II. Average Results, Natural Moisture (Per Cent.).

	Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Millet,	80.00	1.75	1.85	6.91	9.17	.32
Corn,	79.80	1.10	2.00	4.30	12.10	.70

As is to be expected, the different samples of millet vary somewhat in composition, depending upon the stage of growth, weather conditions, fertility of land and possible errors in sampling. The natural tendency is for the fibre to increase as the plant approaches maturity.

Of the total crude protein in sample (d) (6.77 per cent.), 6.02 per cent. was found to exist as true albuminoids and .75 per cent. in the form of amids. The amids thus represented 12.46 per cent. and the albuminoids 87.54 per cent. of the matter calculated as crude protein. This is what might be expected in immature material of this character. The same sample showed 22.46 per cent. of pentosans, representing about one-half of the non-nitrogenous extract matter. It is quite probable, however, that a small quantity of the total pentosans still remained in the crude fibre and could not be counted as extract.

When the analysis of the millet is compared with that of corn fodder, on the basis of dry matter, one striking difference is noted, namely, that the fibre is much in excess in the

millet, and the nitrogen-free extract matter correspondingly less. The millet naturally develops relatively more woody matter than the corn, and for this reason it is necessary to cut the millet for feeding purposes while in blossom. If allowed to grow until the seed is developed, the straw is hard and woody, and quite unsatisfactory for feeding. Corn fodder, the analysis of which is given above, is supposed to be rather thickly seeded corn, with ears more or less developed, and probably cut late in August. It is an advantage to allow the corn fodder when fed green to grow until it has reached the above stage, for the reason that its digestibility and palatability are not appreciably decreased, while the nutritive value is considerably enhanced because of the ear development. The character also of the extract matter in the two fodders is not the same, the corn having a considerable amount of the valuable starch, which is practically lacking in the millet. The principal difference, then, from a chemical stand-point, between these two plants, consists, in case of the corn, in the extra percentage of nitrogen-free extract matter containing considerable quantities of starch, and the smaller percentage of the less valuable woody fibre.

The protein percentage is about the same. The millet shows relatively rather more ash than the corn. This may be due to the fact that it is cut at an earlier stage in its growth. From the comparative chemical analysis of the two plants, as given above, one would naturally expect a greater nutritive effect from the corn than from the millet.

Composition of the Ash (Dry Matter).

Only two analyses of the ash of the millet are on record. One of them was made a number of years ago, and is very incomplete; the other represents a recent analysis of sample (d): —

SAMPLES.	Crude Ash.	Soluble Ash	Insoluble Ash.	Calcium Oxide.	Potassium Oxide.	Phosphoric Acid.	Undetermined.
Sample (d),	8.36	6.33	2.03	.96	3.70	.52	1.15
Earlier sample,	-	-	-	-	1.96	.44	-
Green corn,*	6.12	5.00	1.12	.82	2.18	.60	-

* From Wolff tables, given for comparison; exact stage of growth unknown.

The amount of the several ash constituents will of course vary, depending upon the state of growth, soil moisture and fertility. The above figures are not sufficient to enable one to form any very correct idea of the mineral constituents of the plant; they indicate, however, that the millet takes considerable quantities of mineral constituents from the soil, especially potash, and fully as much as Indian corn at a corresponding stage of growth.

Composition of the Seed.

SAMPLES.	Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Millet seed (1898),	11.47	2.81	9.44	7.69	65.20	3.39
Millet seed (earlier),	10.30	3.10	12.30	7.70	60.90	5.70
Average of both samples,	10.88	2.96	10.87	7.69	63.05	4.55
Oats for comparison,*	11.00	3.00	11.80	9.50	59.70	5.00

* Jenkins's and Winton's tables, average 30 samples.

The millet seed resembles oats very closely in composition. The protein and fibre are a trifle higher in the oats, and the nitrogen-free extract correspondingly lower.

Composition of Millet Silage (Natural Moisture).

	Number Analyses.	Water.	Ash.	Protein.	Fibre.	Nitrogen-free-Extract.	Fat.
Millet,	3	74.0	2.40	1.70	7.50	13.60	.80
Millet and soy beans,*	9	79.0	2.80	2.80	7.20	7.20	1.00
Millet and soy beans,†	2	81.0	2.21	2.04	6.66	7.44	.65
Corn and soy beans,*	4	76.0	2.40	2.50	7.20	11.10	.80
Corn and soy beans,†	1	75.0	1.80	2.35	7.06	13.19	.60
Corn silage for comparison,‡	99	79.1	1.40	1.70	6.00	11.00	.80
Dry Matter.							
Millet,	3	-	9.24	6.50	28.80	52.36	3.10
Millet and soy beans,	11	-	13.06	12.91	34.40	35.07	4.56
Corn and soy beans,	5	-	9.42	10.20	29.63	47.59	3.14
Corn silage for comparison,	99	-	6.60	8.00	28.70	53.00	3.70

* Previous to 1897; approximately two-thirds millet or corn and one-third bean.
† During 1897. ‡ Jenkins's and Winton's tables.

The millet silage and the corn silage, so far as the above figures are concerned, show no great analytical differences. It must not be forgotten, however, that the non-nitrogenous extract matter of the corn contains a considerable amount of starch, which fails in the millet. The mixtures made from millet and corn, with soy beans, were not perfect. The object was to add one-third beans and two-thirds corn in putting the materials into the silo, but this was done only by loads of material and not by actual weight. The analytical results on the basis of dry matter are about what might be expected; namely, an increase in the protein percentage and a decrease in the extract matter in each case, when compared with millet or corn silage. One notes, however, more extract matter in the corn and bean than in the millet and bean silage. The protein and ash are higher in the millet and bean than in the corn and bean silage. This condition is satisfactorily explained on the ground that the millet and bean, being cut at an earlier stage than the corn and bean, would naturally contain relatively more ash and protein and less extract matter.

The Digestibility of Millet.

The following figures represent the digestibility of the different ingredients of millet, and were obtained by the use of sheep at this station. The numbers mean that, of the total amount of ash, protein, etc., contained in the millet, such and such amounts or percentages were digested. Thus, if green millet contains 6.91 per cent. of fibre, 73 per cent. of it is digestible, or $6.91 \times 73 = 5.04$ per cent.

CHARACTER OF MATERIAL.	Number Different Samples.	Number Single Trials.	Dry Matter.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Green millet, early to late blossom, ...	1	3	71	64	69	73	72	63
Dent corn fodder (in milk) for comparison, .	3	9	70	-	61	64	76	78
Millet hay, full blossom,*	1	3	57	63	64	61	52	46
Millet hay, full blossom,†	1	2	56	24	31	63	55	50
Timothy hay for comparison, ...	12	26	57	-	48	52	63	60
Millet silage for comparison,‡	-	-	-	-	-	-	-	-
Millet and soy bean silage, ...	1	4	59	-	57	69	59	72
Corn and soy bean silage,§	1	3	69	-	65	65	75	82
Corn silage for comparison,‖	-	10	71	30	56	70	76	82

* Same plot as green material previously given.

† *Panicum italicum*, — a different species of Japanese millet.

‡ No digestion tests have been made.

§ Pride of North corn (dent) and medium green soy beans, two-thirds former and one-third latter, in excellent condition.

‖ Average dent and flint.

The green millet appears, from the figures at our disposal, to be as digestible as the fodder corn.

The millet hay shows a very much less degree of digestibility than the same material green. Generally speaking, the mere withdrawal of the water is not supposed to affect digestibility, and this is likely to be the case with young and tender plants and with grains that can be ground fine. In the case of coarse, woody plants the reverse is likely to be true. The hardening of the woody stalks in the curing process, and the less perfect mastication resulting, in all probability are the most important factors in bringing about this apparent result. We hope to make other experiments to still further prove this point. Unfortunately, no figures are on hand for the millet silage. The corn and bean silage shows about 10 per cent. more total digestible matter than the millet and bean silage. The extract matter of the former is noticeably more digestible. The high degree of digestibility of the extract matter of the corn and bean silage is explained when one remembers the considerable amount of corn grains present. Corn and soy bean silage, as shown

by this experiment, appears to be nearly as digestible as average corn silage, and the protein even more so.

Multiplying the percentage composition of the millet, as given in a previous page, by the digestion percentages or coefficients as stated above, one obtains the following percentages digestible in one hundred: —

[Figures equal percentages, or pounds in 100 digestible.]

CHARACTER OF MATERIAL.	FRESH OR AIR-DRY MATERIAL.					DRY MATTER.			
	Dry Matter.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Green millet,	14.20	1.28	5.04	6.60	.20	6.37	25.23	33.01	1.02
Green corn, fodder,	14.14	1.22	2.75	9.19	.55	5.91	18.63	46.06	2.50
Millet hay,	48.45	5.02	17.91	20.25	.63	5.90	21.08	23.84	.73
Timothy hay for comparison,	49.00	4.10	14.70	27.20	1.10	4.80	17.10	31.60	1.30
Millet and soy bean silage,	12.15	1.51	4.90	4.27	.68	7.36	23.74	20.69	3.28
Corn and soy bean silage,	16.70	1.60	4.66	8.64	.62	6.63	19.26	35.69	2.57
Corn silage for comparison,	14.84	.95	4.20	8.44	.66	4.48	20.09	40.28	3.12

Millet hay is assumed to contain 15 per cent. of water and timothy hay 14 per cent. It is doubtful if the water content of the millet could be brought as low as 15 per cent.

The above figures tell the same story as those representing the *composition* of the several materials, namely, the excess of fibre and the lack of extract matter in the millet, as compared with the corn. While the green millet appears to be as digestible as the green corn, *there is more digestible fibre in the millet and correspondingly less digestible extract matter.* The corn silage shows rather less digestible protein than the millet and bean silage, and nearly twice as much digestible extract matter. There is not a great deal of difference between the corn and bean silage and the corn silage, excepting the increased amount of protein in the former.

Utility of Barnyard Millet.

Yield per Acre. — The millet is a heavy yielder of green fodder; from 12 to 18 tons per acre have been grown upon the college farm, on naturally moist land in good condition, while as high as 35 tons per acre have been reported by outside parties. Our own experience has shown it to yield from 12 to 14 tons per acre upon medium loam in good state of fertility, but not naturally very retentive of moisture. Such quantities, however, were produced without the millet appearing to suffer from lack of water; and it is believed that this amount is a conservative estimate of its productiveness, unless the land is especially moist, warm and fertile. If the millet is planted in drills 15 inches apart and allowed to mature, it will yield about 60 bushels of seed per acre, of an average weight of 35 pounds per bushel. When sown broadcast, 90 bushels per acre have been reported.

Millet as a Soiling Crop. — For use as a soiling crop, the seed should be sown broadcast and harrowed in May 10 to 15, at the rate of 12 quarts per acre. The fodder will be ready to cut August 1 or a few days earlier. It is wise to begin cutting before the heads appear, and to continue for twelve days. It cannot be cut to advantage for a much longer period, for the reason that after it is well headed it becomes tough and woody, and the animals refuse a portion of it. In order to secure green millet feed during the entire month of August, a second seeding can be made June 1, and a third about June 20. If green feed of this character is desired in September, later seedings are necessary. We have found it advantageous to sow peas with the first seeding of millet, at the rate of one and one-half bushels of Canada peas together with six quarts of millet per acre. The peas are first deeply harrowed in, and the millet covered with a tooth harrow. If the weather should prove cool during May and June, the peas are likely to get ahead of the millet, but the latter catches up as the warm weather comes on. This pea and millet mixture makes a desirable green feed. No experiments have been made to measure the feed-

ing value of green millet for milk production, for the reason that the time in its growth when it is available is too short to secure any very reliable data. We have fed the green millet to the station herd during the first three weeks of August for a number of years. During the first week of the cutting the animals eat it well, but the second week a considerable portion of the stems remain unconsumed. Millet acts as a laxative as well as a diuretic, and it is not advisable to feed it as the entire source of coarse fodder. Fed in this way, we have observed that the bowels become very loose, the animals soon refuse to eat above 60 pounds per day, and they lose in flesh and milk production. When they are fed entirely in the barn or yard, 10 pounds of hay per day, together with what green millet they will eat, is a desirable quantity. This usually amounts to about 50 or 60 pounds of millet daily. When animals run in pastures, a supplementary feeding of green millet at night is quite helpful.

From our observations we prefer corn fodder to millet as a green feed, because more milk is secured and the animals tend to keep in better condition. The corn fodder can be fed for a longer period than the millet, and, being more or less eared, its nutritive value is thereby enhanced. Millet, on the other hand, has the advantage of requiring less labor to grow than corn, as after it is once sown it requires no further attention until ready to cut.

Millet as a Hay Crop. — Brooks,* a number of years since, called attention to the fact that, although the yield of hay was from 3 to 6 tons per acre, the difficulty of properly curing it was such that the millet could not be very satisfactorily utilized as a hay crop. We can simply confirm this. The coarseness of the fodder renders it very difficult to eliminate sufficient of the water to enable the hay to keep well unless several extra hay days follow one another; the hay therefore is likely to become musty and consequently unsatisfactory for feeding, and the farmer cannot depend upon it as a rule to furnish him with any considerable amount of dry fodder.

* *Loco citato.*

Millet as a Grain Crop. — According to Brooks,* the birds have a great liking for the seed and it is therefore difficult to harvest without loss. The yield of one ton to the acre is small, as compared with an average crop of corn. Brooks and Smith fed millet meal to four dairy cows, comparing it to an equal quantity of ground oats, and noted no difference in the results (experiment not published). The cost of threshing the grain is to be considered, and the straw would be quite inferior to corn stover for fodder purposes. It does not seem probable that the grain could be made an economic feed for farm animals.

Millet for Silage. — Millet makes a very fair silage, but, as a result of the writer's experience, it is not considered equal to maize. So far as known, there are no exact feeding experiments on record comparing these two plants for silage purposes. It lacks the large quantity of digestible starchy matter which the corn contains in the form of the grain. It could not be put into the silo after it had ripened its seed, as is the case with corn, for the straw would then be dry and tough, and the seed is covered with a hard seed-coating. Our observations have convinced us that millet silage has less nutritive effect than corn silage. The digestion experiments with millet and bean silage, as compared with corn and bean silage, confirm this opinion. We have also noticed that animals are inclined to consume a larger quantity of corn than of millet silage, especially when fed for a considerable length of time. While the labor involved in growing a crop of millet is certainly less than in growing a crop of corn, the extra work in harvesting the former for the silo makes up for it, at least to a considerable degree. If for any reason, however, the corn crop should fail, and millet could be advantageously grown, it would certainly make a very desirable substitute for the former. Millet and soy bean silage is preferable to millet silage, from a nutritive stand-point; but the cost of growing and harvesting the same prevents its general use.

The following estimate of the value of millets on the farm is made in Farmer's Bulletin, 101, already referred to, and

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* *Loco citato.*

it so fully expresses the writer's estimate of the utility of barnyard millet that it is quoted in full: —

On the whole, it is doubtful if there are many sections in this country where millets should be made a primary crop. Their place is rather that of a supplementary one, — a "catch-crop," when the corn has been destroyed by hail or otherwise; a substitute for corn, where that crop is not easily grown; a crop to be grown on a piece of land that might otherwise lie idle; a readily available crop for use in short rotations; an excellent thing to grow on foul land, to get rid of weeds, giving practically the same results as fallowing or summer cultivation, and in addition a crop of forage; a supplement to the regular and permanent pastures and meadows. It is in such ways that the millets are most valuable on the average farm, and such is the place they should be given in American agriculture.

C. — DRIED DISTILLERY GRAINS.

What They are. — Dried distillery grains consist of the residue remaining in the process of manufacturing alcohol, spirits and whiskey from the several cereals. Briefly stated, the process consists in grinding the various grains employed and heating them with a solution of malt, thus converting the starch into sugar. The addition of yeast converts the sugar into alcohol, which is then distilled, and the residue or distillery slop is filtered, dried in especially constructed driers and put upon the market as a cattle food. It consists chiefly of the hulls, germ and protein of the grains. It has a more or less sour taste and smell, because of the fermentation. If the slop remains undried too long, this sour condition is increased. Well-informed parties state that the quality of the dried grains depends, in the first place, upon the composition of the distillers' mashes (*e.g.*, the kinds and proportions of the grains employed); secondly, upon the distillers' mode of mashing and fermenting; and, thirdly, somewhat upon the process of drying.

How They may be classified. — The dried grains may be classified as follows, depending upon the source from which they are derived: —

A. Alcohol and spirits grains.
B. Bourbon whiskey grains.
C. Rye whiskey grains.

The grains produced from *alcohol and spirits distilleries* are the highest in quality, and of the most uniform grade. Corn is practically the only grain used.

The grains produced by *whiskey distilleries* vary according to the proportion of corn, rye and malt contained in their mashes. The larger the proportion of corn and the smaller that of rye and malt (small grain, so called), the higher the grade of dry grains produced. Some bourbon whiskey distillers use very little "small grains," and their product stands near that of Class A. Many make bourbon, half rye and pure rye whiskey alternately in one season, and their product of dried grains varies in quality accordingly. Others, especially in Pennsylvania and Maryland, produce rye grains only.

Their Average Composition. — A large number of analyses of Class A grains are said to show an average of 35.33 per cent. of protein and 11.25 per cent. of fat.

Class B, or bourbon whiskey grains, run from 23.9 to 38.06 per cent. of protein and from 6.3 to 15 per cent. of fat.

Class C, or rye grains, show from 17.85 to 24.28 per cent. of protein and from 5.04 to 7.5 per cent. of fat, averaging 20.87 per cent. protein and 6.32 per cent. fat.

Where manufactured. — The grains derived from spirits and alcohol are manufactured chiefly in Illinois and Indiana, those from bourbon whiskey in Kentucky, and those from rye whiskey in Pennsylvania and Maryland. All grades are produced in Ohio and Wisconsin.

The Yearly Product. — According to the last annual report of the commissioner of internal revenue (page 104),

there were used in the distilleries of the United States during the fiscal year ending June 30, 1900: —

Bushels corn,	16,277,034
Bushels rye,	4,070,861
Bushels malt,	2,721,124
Bushels wheat,	27,225
Bushels oats,	15,414
Bushels barley,	1,328
Bushels mill feed and other materials,	1,276
Bushels grain of 60 pounds,	23,114,262

At present the annual output of distillers' dried grains in this country is less than 40,000 tons; but, if all the distillery slop were dried by perfect machinery, the country would produce about 170,000 tons yearly. The output of single distilleries varies from 1½ to 40 tons per day. Alcohol and spirits grains are produced in the largest establishments, which are generally operated throughout the year. Bourbon and rye whiskey grains are produced in smaller distilleries, rarely turning out more than 5 tons per day, and they are in operation only between November and July.

Where Distillers' Grains are consumed. — Very few grains have been thus far used in the United States, they being mostly exported and consumed in Germany. Statistics of the quantity exported have been lacking until recently, because of the classification employed. The export of distillers' dried grains, brewers' dried grains and malt sprouts, from July 1 to Oct. 31, 1900, was 22,347 tons, or about 5,600 tons per month. How much of this is distillers' dried grains is a trifle uncertain. It is estimated that the exports from July to October consisted of about 50 per cent. brewers' dried grains, 35 per cent. distillers' dried grains and 15 per cent. malt sprouts; that from January 1 to June 30 distillers' grains will predominate, and that the total export of the latter will amount to about 28,000 tons during the present fiscal year.*

* For the larger part of the above information we are indebted to the J. W. Biles Company, Cincinnati, O.

We understand it is the intention to introduce this material in our eastern markets. Our inspectors have already noticed it occasionally. For convenience in distinguishing the different qualities, the sellers have divided the various products into five grades, namely, "R," "X," "XX," "XXX" and "XXXX." Those marked "R" are lowest in protein and fat, and those marked "XXXX" highest. Some two years since, this department secured several tons of these grains. They were analyzed, tested for digestibility and fed to milch cows.

Composition of Distillers' Grains.

CONSTITUENTS.	Brand "R."	Brand "X."	Brand "XX."	Brand "XXX."	Brand "XXXX."
Water,	7.00	7.00	7.00	7.00	7.00
Protein,	16.67	29.76	26.20	30.01	35.46
Fat,	5.68	10.88	9.77	11.90	10.04
Extract matter,	56.87	40.89	43.00	38.09	34.14
Fibre,	12.74	9.77	11.53	10.33	11.63
Ash,	2.04	1.70	2.50	2.07	1.73
Total,	100.00	100.00	100.00	100.00	100.00

The several grades showed between 7 and 8 per cent. of water; for the sake of uniformity, they were all calculated to a 7 per cent. basis.

The sellers state that the markings on "X" and "XX" must have been reversed, as the "XX" grains should show a higher percentage of protein than those marked "X." The "R" grains, as the sellers claim, are the poorest in composition, showing in this particular lot 16.67 per cent. of protein and 5.68 per cent. of fat, — about equal to the amounts found in wheat bran. The others gradually increase in these two ingredients, the "XXXX" showing 35.46 per cent. of protein and 10.04 per cent. of fat. The fibre is not excessive, being from 2 to 4 per cent. more than in bran. The analyses show these materials to be valuable feeding stuffs and worthy of the attention of feeders, providing they are sold on a guaranty. The sellers state that a guaranty will always accompany the different grades.

Digestibility of Distillers' Grains.

Digestion tests were made with sheep, and the following co-efficients obtained: —

CONSTITUENTS.	Brand "R."	Brand "X."	Brand "XX."	Brand "XXX."	Brand "XXXX."	Average, excepting Brand "R."
Total dry matter, .	58	87	84	76	77	81
Protein, . . .	59	73	77	74	71	74
Fat, ...	84	93	95	93	96	94
Extract matter, . .	67	89	84	75	79	82

Excepting the "R" brand, these materials show relatively high digestibilities, with comparatively small variations. In the last column is given an average of the four "X" brands, which may represent the average digestibility of distillery grains made largely from corn.

Multiplying the composition by the percentages digestible, one obtains the *percentage or pounds in 100 digestible:* —

CONSTITUENTS.	Brand "R."	Wheat Bran for Comparison.
Dry matter, ...	58.94	54.29
Dry matter contains: —		
Protein, ...	9.84	12.60
Fat, ...	4.77	3.20
Extract matter, ...	37.43	35.40
Organic nutrients (excluding fibre) digestible, . . .	52.04	51.20

The "R" brand appears to contain about the same quantity of digestible nutrients as does wheat bran. The latter contains rather more protein, and a trifle less fat and extract matter digestible than the former.

CONSTITUENTS.	Brand "X."	Brand "XX."	Brand "XXX."	Brand "XXXX."	Gluten Feed for Comparison.*
Dry matter,	80.91	78.12	70.68	71.61	77.28
Dry matter contains: —					
Protein,	21.72	20.17	22.21	27.30	22.50
Fat,	10.12	9.28	11.07	9.64	3.30
Extract matter,	36.39	36.12	29.02	26.96	43.80
Organic nutrients, excluding fibre digestible.	68.23	65.57	62.30	63.90	69.60

* We refer to such well-known brands as Buffalo, Davenport, Rockford, being the residue from the glucose factories.

These several brands are quite similar in digestible ingredients to gluten feed, and for the present they can be considered as having approximately an equal value. They have noticeably more digestible fat and less digestible extract matter than the latter. They are likely to vary more in composition from time to time than the regular gluten feeds. The highest grade would probably contain rather more protein.

Tests with Milch Cows.

We were not in a position at the time to carry on any exact experiments with dairy animals. The several lots of grain were, however, fed to a number of cows, and the results were as good as one would naturally expect. The animals ate them well, receiving 3 or 4 pounds daily, mixed with wheat bran; the milk yield was satisfactory. We see no reason why the quality of the milk and butter should not be equal to that derived from animals fed upon corn silage, dried brewers' grains, etc. It would probably be wise not to feed such materials to animals when the milk was intended for infant feeding. Should these grains be generally introduced, it would be advisable to note particularly their influence, if any, on the flavor of milk and butter.

Several years since, a considerable quantity of so-called Atlas gluten meal was sold in Massachusetts and Vermont. This was dry distillery grains, sold by a distilling company in Peoria, Ill. It was not accompanied by a guaranty, and

varied from 22 to 36 per cent. of protein. It has not been in the market of late. Hills* fed this material (testing 35 per cent. of protein) to milch cows, and secured very satisfactory results. Its effect on the flavor of milk and butter was not mentioned, and we can assume it was satisfactory. He considered it the cheapest source of protein in Vermont markets at the time.

D.—DIGESTION EXPERIMENTS WITH SHEEP.

These experiments were made during the winter of 1898–99. The method employed was the usual one, as described in the eleventh report of the Massachusetts State Experiment Station for 1893. The full data will be published at another time. By digestion coefficients is meant the percentages of protein, fat, etc., that the animal is capable of digesting. Thus, if wheat bran contains 16 per cent. of protein, or 16 pounds in 100, and the percentage digestible or digestion coefficient is 78, it means that the animal can digest 78 per cent. of the 16 pounds, or 12.46 pounds.

Description of Feed Stuffs.

Hay.—This hay was used in connection with the several concentrated feeds. It was largely Kentucky blue grass, with a small admixture of red clover. It was cut in bloom.

Meadow Fescue.—This was grown on an experimental plot, on land in an average state of fertility. It was free from weeds or other grasses.

Kentucky Blue Grass.—Same conditions as for meadow fescue.

Tall Oat Grass.—Same conditions as for meadow fescue.

Distillery Grains.—Fully described on pages 44–50. The digestibility of the fibre varied to such an extent with the different sheep that no digestion coefficient is presented. It seems to be very digestible in the various "X" brands, possibly 75 or more per cent.

Oat Feed.—This food consisted of the refuse from the oatmeal mills. It was quite an inferior sample of its kind,

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* Vermont Experiment Station report, 1895, p. 222.

containing a large quantity of hulls. The sheep digested only one-third of it.

Rye Feed. — This material is a mixture of rye bran, with a considerable quantity of fine middlings.

Chop Feed. — This consists of the hull, bran and broken germs of Indian corn, and is one of the residues remaining in the manufacture of starch and glucose. The sheep digested this material very unevenly, and the digestion coefficients given represent the average results from six sheep. They are not as satisfactory as could be desired.

Cleveland Flax Meal. — Linseed meal, with the oil quite thoroughly extracted by the naphtha process.

Parsons' "Six Dollar" Feed. — Fully described on pages 53, 54.

Digestion Coefficients resulting from Digestion Experiments.

KIND OF FEED STUFF.	Number of Different Samples.	Number of Single Trials.	Dry Matter (Per Cent.).	Protein (Per Cent.).	Fat (Per Cent.).	Extract (Per Cent.).	Fibre (Per Cent.).	Ash (Per Cent.).
Hay, largely June grass in bloom (*poa pratensis*).	1	6	59	61	47	62	57	48
Meadow fescue, full bloom (*Festuca elatior pratensis*).	1	2	61	52	54	59	67	46
Kentucky blue grass, full bloom (*poa pratensis*).	1	1	56	57	42	53	63	42
Tall oat grass, late bloom (*Arrhenatherum elatius*).	1	2	55	51	56	58	55	41
Distillery grains, Brand "R," . . .	1	2	58	59	84	67	?	-
Distillery grains, Brand "X," . . .	1	2	87	73	93	89	?	-
Distillery grains, Brand "XX," . . .	1	2	84	77	94	84	?	-
Distillery grains, Brand "XXX," . .	1	2	76	74	93	75	?	-
Distillery grains, Brand "XXXX," . .	1	2	77	71	96	79	?	-
Oat feed (large amount hulls), . . .	1	3	34	62	92	83	27	13
Rye feed, ...	1	8	82	80	90	88	?	35
Chop feed, ...	2	6	80	67	82	84	82	-
Cleveland flax meal, ...	1	2	87	83	76	94	?	21
Parsons' "six dollar" feed, ...	1	2	56	57	81	64	47	12

E.—THE COMPOSITION OF PURSLANE (*Portulaca oleracea*).

During the present summer this department received a letter from a Massachusetts farmer inquiring concerning the feeding value of purslane. He stated that he had been feeding it to his cows, and had noticed a decided increase in the quantity of milk; and that, while the animals at first refused to eat it, they soon became accustomed to it, and consumed considerable quantities daily. At the time we had no analysis of the material on hand, consequently a sample was procured and examined. Since making the analysis, we have found a similar analysis made by the Indiana station.* The results are presented below:—

	Green Material.						Water-free Material.				
	Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Massachusetts station, .	90.90	1.55	2.28	1.61	3.42	.24	17.08	25.11	17.71	37.44	2.66
Indiana station, . . .	86.56	2.23	1.81	2.12	6.49	.50	-	-	-	-	-
Corn fodder for comparison,	79.80	1.10	2.00	4.30	12.10	.70	5.20	9.70	21.30	60.60	3.20

The analyses show that the plant contains a very large percentage of water, mineral constituents and nitrogenous matter (protein).

The Missouri station* found .29 per cent. of nitrogen, .85 per cent. of potash and .045 per cent. of phosphoric acid in the green matter, equivalent to approximately 2 per cent. of nitrogen, 6 per cent. of potash and .3 per cent. of phosphoric acid in dry matter. We have found .37 per cent. of nitrogen, equivalent to 4.1 per cent. of nitrogen in dry matter. The percentage of potash present in the Missouri sample is exceptionally large. The plants selected by us must have been in an earlier stage of growth than those of the Indiana and Missouri stations, for both the water and the protein content are very high.

* Farmers' Bulletin, 119, Department of Agriculture.

The above results show that purslane takes large quantities of water, nitrogen and potash from the land, and must be considered a great soil exhauster.

Plumb* has fed purslane to pigs with quite satisfactory results. If dairy animals can be induced to eat it, it would quite naturally increase the flow of milk, because of its high protein content. Whether it would produce any undesirable flavor in the milk, has not been observed.

It being a most objectionable weed where clean cultivation is desired, growing and spreading with wonderful rapidity, and being at the same time a large consumer of plant food, it would hardly be considered a desirable fodder crop on most farms. Whether it has any special ability to dissolve and utilize ordinarily insoluble plant food, has never been determined.

Purslane has been frequently used in many sections as a pot herb, being cooked in a similar way to spinach, etc. It is thus highly esteemed by many.

F. — PARSONS' "SIX DOLLAR" FEED.

The station frequently receives letters requesting information relative to the value of this material. We think Mr. Parsons himself quite fairly states in his circular what this feed is. He says: "It is composed principally of the hulls of different kinds of grains and other low-grade stuff from grain mills and elevators." A sample lot was procured for us by an outside party. In appearance it seemed to consist of the chaff of different grains. It analyzed as follows: —

	Water.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Parsons' feed,	11.00	7.90	9.99	17.89	51.10	2.12
Oat hulls for comparison,	14.30	10.00	4.00	34.00	36.20	1.50

It is quite evident from the above analysis that this sample of the feed contained a considerable quantity of hulls, chaff,

* Bulletin, 82, Indiana Experiment Station.

etc., because of the presence of so large an amount of fibre. It contained, however, in addition, other grain refuse and sweepings, for there is considerable more protein and extract matter than would be found in clear hulls.

The material was fed to sheep, to ascertain its digestibility. These animals were induced to eat it after a little effort. The figures following represent the *percentages digestible* of the total amounts of the several ingredients contained in the feed, and are termed digestion coefficients: —

	Dry Matter.	Ash.	Protein.	Fibre	Nitrogen-free Extract.	Fat.
Parsons' "six dollar" feed, .	56	12	57	47	64	81
Oat hulls for comparison, . .	-	-	35	57	45	35

This lot showed a degree of digestibility approaching average late-cut English hay, and superior to oat hulls. How much different lots are likely to vary in quality, we cannot state. Considerable difference in quality would naturally be expected.

We endeavored to feed this material to cows, as a partial hay substitute, but the animals could not be induced to eat it. This was in the spring of the year. It is possible that in the winter some of it might have been consumed with satisfactory results. It is dry, possesses considerable fertilizing value, having 1.60 per cent. of nitrogen, and is chiefly useful as an absorbent. We have not determined its content of phosphoric acid and potash. Oat hulls show .45 per cent. of potash and .13 per cent. of phosphoric acid. A conservative estimate of its fertilizing value would be $3 per ton.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.
Assistants: HENRI D. HASKINS, SAMUEL W. WILEY, JAMES E. HALLIGAN.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1900.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 55; of these, 33 have offices for the general distribution of their goods in Massachusetts, 8 in New York, 6 in Connecticut, 2 in Vermont, 2 in Rhode Island, 1 in Canada, 1 in Maine, 1 in New Jersey and 1 in Illinois.

Two hundred and forty-four distinct brands of fertilizer, including chemicals, have been licensed in the State during the year.

Four hundred and forty-three samples of fertilizers have thus far been collected in the general markets by experienced assistants in the station.

Three hundred and seventy-two samples were analyzed at the close of November, 1900, representing 251 distinct brands of fertilizer. These analyses were published in three bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 65, March; No. 68, July; and No. 70, November, 1900.

The samples not already analyzed, together with others that may be collected before the first of May, 1901, will be examined with a view of being published in our spring bulletin. It has not always been possible to secure a complete list of the samples licensed in the State; but as thorough a canvass as possible is annually made, varying more or less the towns to be visited from year to year, as seems advisable to the inspector. The methods of sampling are those laid down by our State laws for the regulation of the trade in commercial fertilizers.

For the readers' benefit the following abstract of the results of our analyses is here inserted: —

	1899.	1900.
(a) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	16	15
Number with two elements above the highest guarantee,	27	24
Number with one element above the highest guarantee,	73	85
Number with three elements between the lowest and highest guarantee,	88	118
Number with two elements between the lowest and highest guarantee,	84	92
Number with one element between the lowest and highest guarantee,	58	43
Number with three elements below the lowest guarantee,	-	1
Number with two elements below the lowest guarantee,	19	11
Number with one element below the lowest guarantee,	68	50
(b) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee,	7	5
Number with one element above the highest guarantee,	32	20
Number with two elements between the lowest and highest guarantee,	20	19
Number with one element between the lowest and highest guarantee,	27	6
Number with two elements below the lowest guarantee,	2	-
Number with one element below the lowest guarantee,	18	20
(c) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee,	10	15
Number between the lowest and highest guarantee,	16	9
Number below lowest guarantee,	10	10

A comparison of the above-stated results of our inspection with the results of 1899 shows, with the exception of those fertilizers which are classed under (*b*) (where two essential elements of plant food are guaranteed), a marked superiority in favor of the samples analyzed in 1900.

From a careful scrutiny of the results of analyses published in the three bulletins during the year it becomes an easy matter for the farmer to intelligently select his fertilizers for the next year's consumption, always bearing in mind that the fertilizer costing the least per ton is not always the most economical fertilizer to buy, but rather the one that will furnish the greatest amount of nitrogen, potassium oxide and phosphoric acid, in a suitable and available form, for the same money.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1899 and 1900 (Cents per Pound).

	1899.	1900.
Nitrogen in ammonia salts,	15.0	17.0
Nitrogen in nitrates,	12.5	13.5
Organic nitrogen in dry and fine-ground fish, meat, blood and in high-grade fertilizers.	14.0	15.5
Organic nitrogen in fine bone and tankage,	14.0	15.5
Organic nitrogen in medium bone and tankage,	10.0	11.0
Phosphoric acid soluble in water,	4.5	4.5
Phosphoric acid soluble in ammonium citrate,	4.0	4.0
Phosphoric acid in fine-ground fish, bone and tankage,	4.0	4.0
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.0	4.0
Phosphoric acid in coarse fish, bone and tankage,	2.0	3.0
Phosphoric acid insoluble (in water and in ammonium citrate) in mixed fertilizers.	2.0	2.0
Potash as sulfate (free from chlorides),	5.0	5.0
Potash as muriate,	4.25	4.25

The cost of some of the leading forms of nitrogen shows a marked increase, as compared with the preceding year, 1899.

The above trade values are based on the market cost, during the six months preceding March, 1900, of standard raw materials which are largely used in the manufacture of compound fertilizers found in our markets. The following is a list of such materials: —

Sulfate of ammonia.	Dissolved bones.
Azotine.	Acid phosphate.
Cotton-seed meal.	Refuse bone-black.
Linseed meal.	Ground phosphate rock.
Bone and tankage.	High-grade sulfate of potash.
Nitrate of soda.	Sulfate of potash and magnesia.
Dried blood.	Muriate of potash.
Castor pomace.	Kainit.
Dry ground fish.	Sylvinite.
Dry ground meat.	Crude saltpetre.

How to use the table of trade values in calculating the approximate value of a fertilizer: Calculate the value of each of the three essential articles of plant food (nitrogen, phosphoric acid and potassium oxide, including the different forms of each wherever different forms are recognized in the table) in one hundred pounds of the fertilizer, and multiply each product by twenty, to raise it to a ton basis. The sum of these values will give the total value of the fertilizer per ton at the principal places of distribution. An example will suffice to show how this calculation is made: —

Analysis of Fertilizer (Per Cent., or Pounds in One Hundred Pounds of Fertilizer).

Nitrogen, ...	4
Soluble phosphoric acid, ...	8
Reverted phosphoric acid, ...	4
Insoluble phosphoric acid, ...	2
Potassium oxide (as sulfate), ...	10

	Value per Hundred Pounds.	Value per Ton (Two Thousand Pounds).
Four pounds nitrogen, at 15.5 cents, ...	$0 62×20	=$12 40
Eight pounds soluble phosphoric acid, at 4.5 cents, . .	36×20	= 7 20
Four pounds reverted phosphoric acid, at 4 cents, . .	16×20	= 3 20
Two pounds insoluble phosphoric acid, at 2 cents, . .	04×20	= 80
Ten pounds potassium oxide, at 5 cents, ...	50×20	= 10 00
Value per ton, ...	. . . . .	$33 60

The following table gives the average analysis of officially collected fertilizers for 1900: —

Average Analysis of Officially Collected Fertilizers for 1900.

NATURE OF MATERIAL.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers,	11.29	2.95	2.53	4.53	3.79	2.81	10.52	9.02	7.96	7.31	5.40	5.02
Ground bones,	5.06	3.30	2.79	.58	8.29	15.73	24.11	11.31	8.46	6.46	-	-
Tankage,	6.57	4.18	4.02	-	9.68	10.65	19.76	17.67	9.68	-	-	-
Dissolved bone-black,	11.33	-	-	14.75	3.00	.53	18.25	16.00	16.32	15.54	-	-
Wood ashes,	4.59	-	-	-	-	-	1.84	1.00	-	-	6.59	4.75
Kainit,	1.35	-	-	-	-	-	-	-	-	-	12.90	12.00
Nitrate of soda,	1.17	15.75	15.22	-	-	-	-	-	-	-	-	-
Muriate of potash,	1.77	-	-	-	-	-	-	-	-	-	49.55	50.27
High-grade sulfate of potash,	.44	-	-	-	-	-	-	-	-	-	50.78	48.00
Sulfate of ammonia,	.47	21.15	19.00	-	-	-	-	-	-	-	-	-
Acid phosphate,	16.22	-	-	13.82	2.06	.12	16.00	15.00	15.88	13.15	-	-
Cotton-seed meal,	5.70	7.64	7.00	-	-	-	-	-	-	-	-	-
Cotton-hull ashes,	8.05	-	-	-	-	-	10.38	10.00	-	-	24.48	20.00
Sulfate of potash and magnesia,	2.25	-	-	-	-	-	-	-	-	-	24.04	25.93

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State of Massachusetts during the Past Year (May 1, 1900, to May 1, 1901), and the Brands licensed by Each.

Armour Fertilizer Works, Chicago, Ill.: —
- All Soluble.
- Blood, Bone and Potash.
- Ammoniated Bone with Potash.
- High-grade Potato.
- Cape Cod Asparagus Mixture.
- Armour's Grain Grower.
- Bone Meal.
- White Bone Flour.
- Armour's Flower Food.

Wm. H. Abbott, Holyoke, Mass: —
- Animal Fertilizer.
- Eagle Brand for Grass and Grain.
- Tobacco Fertilizer.

American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-hull Ashes.

Butchers' Rendering Co., Fall River, Mass.: —
- Bone and Tankage.

Bartlett & Holmes, Springfield, Mass.: —
- Pure Ground Bone.
- Animal Fertilizer.
- Tankage.

East India Chemical Works (H. J. Baker & Bro., proprietors), New York, N. Y.: —
- Castor Pomace.
- A. A. Ammoniated Superphosphate.
- Complete Potato Manure.
- Strawberry Manure.
- Complete Tobacco Manure

C. A. Bartlett, Worcester, Mass.: —
- Pure Ground Bone.

Berkshire Mills Co., Bridgeport, Conn.: —
- Complete Fertilizer.
- Potato Phosphate.
- Ammoniated Bone Phosphate.

Hiram Blanchard, Eastport, Me.: —
- Fish, Bone and Potash.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Farm and Garden Phosphate.
- Bowker's Hill and Drill Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Potato and Vegetable Fertilizer.
- Bowker's Fish and Potash (Square Brand).
- Bowker's Potato Phosphate.
- Bowker's Market-garden Manure.
- Bowker's Sure Crop Phosphate.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Gloucester Fish and Potash.
- Nitrate of Soda.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulfate of Potash.
- Dried Blood.
- Wood Ashes.
- Ground Bone.

Bradley Fertilizer Co., Boston, Mass.: —
- Bradley's X. L. Phosphate.
- Potato Manure.
- Potato Fertilizer.
- Complete Manure for Potatoes and Vegetables.
- Corn Phosphate.
- Breck's Lawn and Garden Dressing.
- Eclipse Phoshate.
- Niagara Phosphate.
- Fine-ground Bone.
- Muriate of Potash.
- Kainit.
- Double Manure Salts.
- High-grade Sulfate of Potash.
- Nitrate of Soda.
- Dissolved Bone-black.
- Brightman's Fish and Potash.

Joseph Breck & Sons, Boston, Mass.: —
- Breck's Market-garden Manure.

Daniel T. Church, Providence, R. I. (E. Wilcox, general agent): —
- Church's D. Fish and Potash.

Clark's Cove Fertilizer Co., Boston, Mass.: —
- Bay State Fertilizer.
- Bay State Fertilizer, G. G.
- Potato Manure.
- Potato Fertilizer.
- Great Planet Manure.
- King Philip Guano.

Cleveland Dryer Co., Boston, Mass.: —
- Cleveland Superphosphate.
- Cleveland Potato Phosphate.
- Cleveland High-grade Complete Manure.

E. Frank Coe Co., New York, N. Y.: —
- High-grade Ammoniated Bone Superphosphate.
- Special Potato Fertilizer.
- Fish and Potash, F. P.
- Gold Brand Excelsior Guano.
- Tobacco and Onion Fertilizer.
- Vegetable and Vine.
- Bay State Phosphate.
- Market-garden Special Fertilizer.

Crocker Fertilizer and Chemical Co., Buffalo, N. Y.: —
- Crocker's Ammoniated Corn Phosphate.
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's New Rival Ammoniated Superphosphate.
- Crocker's General Crop Phosphate.
- Crocker's Superior Fertilizer.
- Crocker's Grass and Oats Fertilizer.

Cumberland Bone Phosphate Co., Boston, Mass.: —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.

L. B. Darling Fertilizer Co., Pawtucket, R. I.: —
- Potato and Root Crop.
- Blood, Bone and Potash.
- Fine Bone.
- Potato Manure.
- Animal Fertilizer.
- Complete Ten Per Cent. Manure.
- Nitrate of Soda.
- Muriate of Potash.

John C. Dow & Co., Boston, Mass.: —
- Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
- Imperial Liquid Plant Food.
- Imperial Liquid Grass Fertilizer.

Wm. E. Fyfe & Co., Clinton, Mass.: —
- Canada Wood Ashes.

Farmers' Union Fertilizer Co., Peabody, Mass.: —
- Corn King.
- Market-garden Special.
- Complete Potato Fertilizer.
- Ammoniated Bone Fertilizer.

Great Eastern Fertilizer Co., Rutland, Vt.: —
- Northern Corn Special.
- Vegetable, Vine and Tobacco.
- General Fertilizer.
- Grass and Oats Fertilizer.
- Garden Special.

Thomas Hersom & Co., New Bedford, Mass.: —
- Meat and Bone.
- Ground Bone.

F. E. Hancock, Walkerton, Ontario, Can.: —
- Pure Unleached Canada Hardwood Ashes.

Charles W. Hastings, Jamaica Plain, Mass.: —
- Ferti Flora.

Thomas Kirley, South Hadley Falls, Mass.: —
- Pride of the Valley.
- Tankage.

Lowell Fertilizer Co., Boston, Mass.: —
- Swift's Lowell Bone Fertilizer.
- Swift's Lowell Animal Brand.
- Swift's Lowell Potato Phosphate.
- Swift's Lowell Lawn Dressing.
- Swift's Lowell Market Garden.
- Swift's Lowell Fruit and Vine.
- Swift's Lowell Tobacco Manure.
- Swift's Lowell Dissolved Bone and Potash.
- Swift's Lowell Potato Manure.
- Swift's Lowell Ground Bone.
- Swift's Lowell Nitrate of Soda.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Lister's Success Fertilizer.
- Lister's Celebrated Onion Fertilizer.
- Lister's Special Potato Fertilizer.
- Lister's High-grade Special for Spring Crops.
- Lister's Special Tobacco Fertilizer.

Lowe Bros. & Co., Fitchburg, Mass.: —
- Tankage.

The Mapes Formula & Peruvian Guano Co., New York, N. Y.: —
- The Mapes Bone Manures.
- The Mapes Superphosphates.
- The Mapes Special Crop Manures.
- Sulfate of Potash.
- Nitrate of Soda.
- Tobacco Ash Constituents.

Geo. L. Monroe, Oswego, N. Y.: —
- Pure Canada Unleached Wood Ashes.

McQuade Bros., West Auburn, Mass.: —
- Pure Ground Bone.

National Fertilizer Co., Bridgeport, Conn.: —
- Chittenden's Market Garden.
- Chittenden's Complete Fertilizer.
- Chittenden's Ammoniated Bone.
- Chittenden's Fish and Potash.

Pacific Guano Co., Boston, Mass.: —
- High-grade General.
- Soluble Pacific Guano.
- Potato Special.
- Nobsque Guano.

Packer's Union Fertilizer Co., New York, N. Y.: —
- Gardener's Complete Manure.
- Animal Corn Fertilizer.
- Potato Manure.
- Universal Fertilizer.
- Wheat, Oats and Clover Fertilizer.

Parmenter & Polsey Fertilizer Co., Peabody, Mass.: —
- Plymouth Rock Brand.
- Special Potato Fertilizer.
- Special Strawberry Manure.
- A. A. Brand.
- Star Brand Superphosphate.
- Pure Ground Bone.
- P. & P. Potato Fertilizer.

Quinnipiac Co., Boston, Mass.: —
- Phosphate.
- Potato Manure.
- Corn Manure.
- Market-garden Manure.
- Grass Fertilizer.
- Pequot Fish and Potash.
- Havana Tobacco Fertilizer.
- Climax Phosphate.

Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Fertilizer for Oats and Top Dressing.
- Hubbard's Grass and Grain Fertilizer.
- Hubbard's Fairchild's Formula for Corn.
- Hubbard's Soluble Potato Manure.
- Hubbard's Soluble Tobacco Manure.
- Hubbard's Potato Manure.
- Hubbard's All Soils and All Crops.
- Hubbard's Corn Phosphate.
- Hubbard's Raw Knuckle-bone Flour.
- Hubbard's Strictly Pure Fine Bone.

N. Roy & Son, South Attleborough, Mass.: —
- Complete Animal Fertilizer.

Russia Cement Co., Gloucester, Mass.: —
- Essex Dry Ground Fish.
- Essex XXX Fish and Potash.
- Essex Potato Fertilizer.
- Essex Corn Fertilizer.
- Essex Complete Manure for Potatoes and Vegetables.
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Odorless Lawn Dressing.
- Essex Special Tobacco Fertilizer.
- Essex Tobacco Starter.

Rogers Manufacturing Co., Rockfall, Conn.: —
- All Around Fertilizer.
- Complete Potato and Vegetable Fertilizer.
- Complete Corn Fertilizer.
- Fish and Potash.
- High-grade Soluble Tobacco and Potato.
- High-grade Oats and Top Dressing.
- High-grade Grass and Grain.
- High-grade Tobacco Fertilizer.

Read Fertilizer Co., New York, N. Y. (D. H. Foster, general agent): —
- Read's Standard.
- High-grade Farmer's Friend.
- Practical Potato Special.
- Bone, Fish and Potash.
- Samson.
- Potato Manure.
- Vegetable and Vine.

Lucien Sanderson, New Haven, Conn.: —
- Sanderson's Old Reliable.
- Sanderson's Formula A.
- Sanderson's Blood, Bone and Meat.
- Sanderson's Nitrate of Soda.
- Sanderson's Dissolved Bone-black.

Standard Fertilizer Co., Boston, Mass.: —
- Standard Fertilizer.
- Standard Guano.
- Standard Complete Manure.
- Standard Special for Potatoes.
- Standard A Brand.

Thomas L. Stetson, Randolph, Mass.: —
- Ground Bone.

Henry F. Tucker Co., Boston, Mass.: —
- Original Bay State Bone Superphosphate.
- Special Potato Fertilizer.

Darius Whithed, Lowell, Mass.: —
- Ground Bone.
- Champion Animal Fertilizer.

The Wilcox Fertilizer Works, Mystic, Conn.: —
- Potato, Onion and Tobacco Manure.
- High-grade Fish and Potash.
- Dry Ground Fish Guano.
- Fish and Potash.

Williams & Clark Fertilizer Co., Boston, Mass.: —
- High-grade Special.
- Ammoniated Bone Superphosphate.
- Potato Phosphate.
- Corn Phosphate.
- Potato Manure.
- Special with ten per cent. Potash.
- Royal Bone Phosphate.
- Prolific Crop Producer.
- Fine Wrapper Tobacco Grower.
- Bone Meal.

M. E. Wheeler & Co., Rutland, Vt.: —
- Corn Fertilizer.
- Potato Manure.
- Havana Tobacco Grower.
- Superior Truck Fertilizer.
- Bermuda Onion Grower.
- Grass and Oats Fertilizer.
- Electrical Dissolved Bone.

A. L. Warren, Northborough, Mass.: —
- Fine-ground Bone.

Sanford Winter, Brockton, Mass.: —
- Fine-ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
- Tankage.

PART II. — REPORT ON GENERAL WORK IN THE CHEMICAL LABORATORY.

CHARLES A. GOESSMANN.

1. Analysis of materials sent on for examination.
2. Notes on wood ashes.
3. Notes on sludge, its agricultural value.
4. Notes on phosphatic slag, as a source of phosphoric acid for manurial purposes.

1. ANALYSES OF MATERIALS SENT ON FOR EXAMINATION.

During the past season 237 materials have been received and the results of our examination have been published in detail in bulletins 65, 68 and 70 of the Hatch Experiment Station of the Massachusetts Agricultural College, together with the results of the official inspection of commercial fertilizers.

The responsibility of the genuineness of the articles sent on for examination rests in all cases with the parties asking for analyses, and our publication of results merely refers to the locality from which they come. It is evident, from the increase each year of the number of materials sent in for analysis, that there is a growing interest taken in this work, and individuals are realizing the value of such chemical investigations.

The waste products of our industries are becoming from year to year more numerous and important. As the current modes of manufacture are constantly undergoing changes which affect seriously their commercial manurial value, frequent investigation of this class of materials cannot help but prove beneficial to the farmer, and hence arrangements are made to attend to the examination of these materials to the

full extent of our resources. This work is carried on free of charge to the farmers of this State, the results of analysis being returned in the order of the arrival of samples at the office. Below is given a list of materials received during the past season, which shows the general nature of the work: —

Wood ashes,	78	Acid phosphate,	1
Cotton-hull ashes,	8	Dissolved bone-black,	2
Brickyard ashes,	1	Dissolved bone,	2
Leather-scrap ashes,	1	Cotton-seed meal,	4
Lime-kiln ashes,	2	Castor pomace,	1
Lime refuse,	1	Cotton waste,	7
Muriate of potash,	3	Tobacco stems,	3
High-grade sulfate of potash,	2	Tobacco dust,	1
Sulfate of potash and magnesia,	3	Muck,	2
Kainit,	1	Peat,	1
Silicate of potash,	1	Soot,	1
Sulfate of ammonia,	1	Bat guano,	1
Nitrate of soda,	3	Cork dust,	1
Ground bone,	7	Kiln dust,	1
Raw bone flour,	1	Complete fertilizers,	13
Steamed bone meal,	1	Refuse from garbage plant,	1
Tankage,	5	Stable manures,	14
Dry fish meat,	2	Stable refuse material,	1
Florida rock phosphate,	1	Sludge,	7
Phosphatic slag,	1	Soils,	29
South Carolina rock phosphate,	2	Bug death,	1
Apatite,	1	Miscellaneous materials,	22

These, together with other manurial products common to commercial and agricultural industries, are carefully investigated, and the results of our examination are free to the farmers of the State. As our resources are limited, we have to request all farmers sending material for examination to prepay express charges.

2. Notes on Wood Ashes.

During the past year (1900) 30.8 per cent. of the materials sent on for analysis consisted of wood ashes, as against 24.4 per cent. the previous year (1899). The wood ashes sold for manurial purposes in our State are subject to official inspection, and the dealers in this commodity must secure a license to sell before they can legally advertise their article.

The goods must be sold on a guaranteed analysis, stating their percentages of potash and of phosphoric acid present, and this analysis must be fastened to each package or car that contains them. As the dealer is obliged only to furnish a guarantee of the amount of potash and of phosphoric acid present in the ashes, no objection can be raised regarding the amount of moisture, so long as the specified amount of these two elements is present.

Wood ashes ought to be bought and sold by weight, and not by measure, for both moisture and general character of the foreign matters are apt to seriously affect the weight of a given volume. The following table shows the general character of the wood ashes, so far as their chemical composition is concerned, that have appeared in the general markets during the season of 1900: —

Analysis of Wood Ashes.

CONSTITUENTS.	NUMBER OF SAMPLES.	
	1899.	1900.
Moisture below 1 per cent.,	2	1
Moisture from 1 to 10 per cent.,	21	25
Moisture from 10 to 20 per cent.,	35	32
Moisture from 20 to 30 per cent.,	1	13
Moisture above 30 per cent.,	1	1
Potassium oxide above 8 per cent.,	4	1
Potassium oxide from 7 to 8 per cent.,	9	6
Potassium oxide from 6 to 7 per cent.,	13	12
Potassium oxide from 5 to 6 per cent.,	7	25
Potassium oxide from 4 to 5 per cent,	19	14
Potassium oxide from 3 to 4 per cent.,	2	7
Potassium oxide below 3 per cent.,	2	7
Phosphoric acid above 2 per cent.,	4	6
Phosphoric acid from 1 to 2 per cent.,	43	62
Phosphoric acid below 1 per cent.,	10	4
Average per cent. of calcium oxide (lime),	34.10	32.51
Per cent. of mineral matter insoluble in diluted hydrochloric acid: —		
Below 10 per cent.,	16	15
Between 10 and 15 per cent.,	26	35
Between 15 and 20 per cent.,	7	12
Above 20 per cent.,	7	11

To assist our farmers in selecting the best quality of wood ashes in our market, it is desirable that those sending samples for analysis will state the name of the party of whom the goods were purchased and price per ton paid.

3. Notes on Sludge, its Agricultural Value.

The interest in the character of this class of materials and their value for manurial purposes is deservedly steadily increasing, judging from inquiries received at this office. As the source of the article as well as the mode of collecting the same may differ widely, it is but natural that no definite advice can be furnished without a special examination into the existing circumstances. The subsequent compilation of analyses of sludge, made at the request of farmers of the State, are published to increase a more general interest in the matter: —

Analyses of Samples of Sludge (Per Cent.).

[The five samples were received from Worcester, Mass. I., taken from bottom of basin, unpressed; II., taken from top of basin, unpressed; III., pressed sample, yellowish in color; IV., pressed sample, black color; V., pressed sample, reddish color.]

CONSTITUENTS.	I.	II.	III.	IV.	V.
Moisture at 100° C.,	65.99	63.59	54.98	68.15	53.11
Nitrogen,	.44	.38	.49	.36	.62

Analyses of Samples of Sludge (Per Cent.).

[I., Average complete analysis of the above five samples; II., sludge received from Worcester, Mass.; III., sludge received from Brockton filter beds (1899); IV., sludge received from Brockton filter beds (1900).]

CONSTITUENTS.	I.	II.	III.	IV.
Moisture at 100° C.,	61.16	65.61	21.44	2.77
Phosphoric acid,	.39	.47	.86	.72
Potassium oxide,	.13	.07	.16	.66
Nitrogen,	.46	.58	1.31	1.27
Calcium oxide,	5.08	-	1.13	trace.
Ferric oxide,	6.50	-	-	-
Aluminum oxide,	2.05	-	-	-
Magnesium oxide,	2.19	-	-	-
Sulfuric acid (SO_3),	.44	-	-	-
Carbonic acid,	4.86	-	-	-
Chlorine,	trace.	-	-	-
Insoluble matter,	10.57	5.63	-	-

It will be seen from the above analyses that there is a great difference in the percentage of the fertilizing constituents present in the different samples. There remains, however, no doubt that these materials when properly studied furnish a valuable source of plant food, when they can be conveniently obtained, and supplemented by such ingredients as potash and phosphoric acid compounds, to render them more suitable for manurial purposes in case of different crops.

4. Notes on Phosphatic Slag as a Source of Phosphoric Acid for Manurial Purposes.

The phosphatic slag, sometimes called Thomas basic phosphatic slag, or odorless phosphate, in advertisements of dealers of commercial fertilizers, is obtained as a by-product in the conversion of phosphorus containing iron ores into phosphorus free metallic iron. Investigations regarding its fitness as an economical source of phosphoric acid for manurial purposes have received, from the date of its first production, the special attention of agricultural chemists and agriculturists of Germany and other European countries. Field observations in the United States date back, as far as the writer is informed, to the year 1888. Summing up the results of the past, it will be admitted that a genuine phosphatic slag, judiciously applied, has proved a valuable addition to our phosphoric-acid-containing manurial resources, and that its use is only limited by its supply at a reasonable cost.

The subsequent tabular statement may convey some more definite idea regarding the general character of the phosphatic slag tested at Amherst, Mass. : —

Analyses of Phosphatic Slag (Per Cent.).

[I., German phosphatic slag (sent on), 1887; II., English phosphatic slag (sent on), 1887; III., German phosphatic slag (imported for station use), 1888; IV., phosphatic slag received from England, 1888.]

CONSTITUENTS.	I.	II.	III.	IV.
Moisture at 100° C.,	.10	.37	5.08	.37
Ferric and aluminum oxides,	4.26	-	15.98	8.55
Total phosphoric acid,	31.51	18.91	21.05	18.91
Available phosphoric acid,	.19	5.93	-	-
Insoluble phosphoric acid,	30.32	12.98	-	-
Calcium oxide,	41.87	49.82	53.97	49.22
Magnesium oxide,	-	-	3.83	-
Insoluble matter,	13.74	5.06	-	5.06

Analyses of Phosphatic Slag (Per Cent.).

[I., bought for field experiments, 1894; II., sent on from Hatfield, Mass., 1893; III., sent on from Marshfield, Mass., 1893; IV., sent on from Amherst, Mass., 1893; V., sent on from Mansfield, Mass., 1900.]

CONSTITUENTS.	I.	II.	III.	IV.	V.
Moisture at 100° C.,	.47	1.12	.60	.63	.25
Ferric and aluminum oxides,	14.35	-	-	-	-
Total phosphoric acid,	19.04	18.40	19.45	18.42	19.80
Available phosphoric acid,	-	-	-	-	6.04
Insoluble phosphoric acid,	-	-	-	-	13.76
Calcium oxide,	46.47	49.00	61.30	48.27	52.93
Magnesium oxide,	5.05	-	-	-	-
Carbonic acid,	-	2.67	2.25	-	-
Potassium oxide,	-	.32	.52	-	.50
Insoluble matter,	4.39	7.20	5.12	5.53	-

The analyses of phosphatic slag in earlier years, as a rule, show lower percentages of ammonium citrate soluble phosphoric acid when subjected to the same current mode of treatment as other phosphatic fertilizers, — a circumstance due to the presence of a varying quantity of caustic lime, which caused a decomposition of the citrate of ammonia, and thus affected more or less seriously its power to dissolve the available phosphoric acid present. The recognition of this fact on the part of chemists has caused the adoption of a modification in the character and the concentration of the citrate of ammonia solution proposed by Dr. P. Wagner, which aims at a neutralization of the free lime. The determination of available phosphoric acid in phosphatic slag, by Wagner's method, for trade purposes is to-day generally adopted. As our above-stated analyses of phosphatic slag extend over a period of more than twelve years, the main interest in our results consists in the statement of the amount of total phosphoric acid found present.

Aside from these recent changes in the current modes of analyzing these phosphates, there has been introduced an important change in the manufacture of phosphatic slag for manurial purposes. As in the fertilizer trade, the valuation

of the phosphoric acid is based, as a rule, on the amount of available phosphoric acid present. Manufacturers of phosphatic slag have aimed at the production of a material which, by chemical analysis, will show the largest amount of available phosphoric acid; this result is obtained by fusing the slag at about 900° C. with sufficient quartz sand to change the free lime present into silicate of lime. The inventor of this process (G. Hoyermann) has published as an illustration the following results: —

Analyses of Thomas Phosphatic Slag (Per Cent.).

[I., analysis of Thomas phosphatic slag before smelting with quartz sand; II., analysis of the same material after fusing with quartz sand.]

CONSTITUENTS.	I.	II.
Calcium oxide (free lime),	11.00	.70
Silicic acid,	2 to 3	12.00
Available phosphoric acid (percentage of whole),	58.00	84.00

The general introduction of Hoyermann's process has changed the character of the phosphatic slag of earlier years materially. The phosphatic slag of to-day contains, in exceptional cases only, some free lime, not sufficient to charge any beneficial effect of the phosphatic slag on the crop raised to free lime present.

An imitation of phosphatic slag is reported as having been introduced in Sweden. It is obtained by fusing apatite with soda ash at from 700° to 800° C. No representative sample of this material has yet come to the writer's notice.

REPORT OF THE BOTANISTS.

G. E. STONE, R. E. SMITH.

The work of this division during the past year has consisted as usual in the investigation of various forms of plant disease, together with a large amount of correspondence, the preparation of results for publication, and miscellaneous botanical work. Bulletin No. 69, on "The rotting of greenhouse lettuce," was issued during the year, giving an account of the work on this subject, to which reference has been made in several recent annual reports of this station. The extent of the lettuce-forcing industry in this State makes the subject of this bulletin one of great importance, as the financial loss from this source has been a large and increasing one. Notably in the case of the disease known as the "drop," the least understood and the most destructive of these troubles, results have been obtained which show hitherto entirely unknown characteristics in the development of the organism which causes the trouble, on the basis of which knowledge a practical and efficacious treatment can be applied. Another result of no small importance has been the demonstration of the worthlessness of many so-called remedies.

Our greenhouses used for purposes of experiment have as usual been devoted to the study of problems connected with the forcing of vegetables, principally cucumbers, in addition to lettuce.

Aster Diseases.

During the past summer, work on the diseases of the China aster has been continued, upon a much more extensive scale than heretofore. Altogether some 15,000 plants were grown, and a great variety of experiments were conducted upon fertilizers, varieties, localities, time of planting, methods of

handling, etc. In one bed, 600 feet in length, were grown all the varieties of this plant obtainable from the leading seedsmen of the country, over 300 in all. This plant is very generally affected by a number of serious troubles, most prominent of which is a disease of a peculiarly obscure nature. No organism of any kind appears to be the cause of it, yet it has a very characteristic as well as destructive effect. Our most recent results indicate that the abnormal development is due to a disturbance of the assimilative (metabolic) functions of the plant. The conditions, however, which bring about this disturbance, seem, as shown by our results thus far, contradictory and obscure. At least three other diseases, all of a fungous nature, also attack the aster, with serious effects. These can be more readily understood, if not prevented. Complaint is made from all parts of the country of trouble in growing this popular flower.

Nematode Worms.

A peculiar disease on potted cuttings of perennial phlox was sent in during the past winter, which proved to be caused by a species of nematode, but quite different from that attacking the roots of many plants, to which this division has devoted considerable attention. This new form attacks the stem of the plant, causing there an abnormal enlargement, while the leaves are stunted or reduced to mere rudiments, and the plant generally dies. The worm causing the mischief is a slender creature of microscopic size, which embeds itself in the tissues of the stem, where it multiplies rapidly and produces the abnormal growth. The species is an undescribed one, though it appears to be the same as that mentioned by several writers as attacking the stems and leaves of plants. This is the only occurrence of the sort which we have known in this State, and from its nature it does not appear to be anything which will become generally prevalent or destructive.

Cucumber Mildew (*Plasmopara Cubensis*, B. and C.).

This mildew made its appearance in Massachusetts during the past autumn for the first time, so far as we are aware,

since 1889, when it was reported by Dr. Humphrey * as found in two distinct localities in the State. This time it is again reported as occurring upon greenhouse cucumbers in two entirely distinct and remote localities, namely, Beverly and Leominster, but we are not aware of its presence during the summer on out-door cucumbers, squashes or melons. The fungus occurs more commonly in the south, and even no further remote than Ohio and Long Island it has proved exceedingly disastrous to out-door crops. It is surmised by Professor Selby of Ohio that it persists in the south and works its way northward as the season advances. The notable results in Long Island, obtained by Stewart, † in spraying with the Bordeaux mixture cucumbers affected with this mildew, show that the disease can be practically controlled.

The fungus appears largely upon the under side of the leaf, as a downy mass, greatly resembling the downy mildew of the grape. It must not, however, be confounded with the common powdery mildew found so frequently upon the upper surface of cucumber leaves. It is, moreover, more disastrous than the powdery mildew, and on this account should not be neglected when found.

Russian Thistle in Massachusetts.

The first report of the finding of the Russian thistle in Massachusetts which has come to our notice is made by Mr. Wm. P. Rich. ‡ Two plants were first observed by him on a railroad bank at Dedham, Aug. 22, 1897, and since that time the plants have shown a tendency to increase slightly. Mr. Rich states that on Aug. 4, 1900, he found in the same locality twenty plants. A few of them had spread three hundred feet from where first observed in 1897. The Russian thistle has been previously reported in New York and Rhode Island.

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* Eighth annual report, Massachusetts Agricultural Experiment Station, p. 210.

† New York Agricultural Experiment Station Bulletin, No. 119, Geneva, N. Y.

‡ Rhodora, Vol. II., p. 204.

Influence of Chemical Solutions upon the Germination of Seeds.

It is well known that there are many chemical solutions which accelerate and retard the germination of seeds; it is also known that germinating seeds are very susceptible to changes in temperature and moisture, to variations in the degree and kinds of light, to the amount of oxygen they receive, to the influence of electricity, etc. It was our idea, in inaugurating these experiments, to determine to what degree seeds could be accelerated in their germination, and also to what extent their germinating capacity could be increased. Experiments in this direction have been carried on in this department since 1895, but they have been interrupted a number of times. These experiments have been directed along two lines, namely, a study of the influence of physical factors upon germination, and a study of the effects of different chemical solutions upon germination. The results of the former experiments have already been published, in a bulletin entitled "Electro germination;" while some of the results of the latter, which have been carried on by Mr. E. H. Sharpe, at one time a student in the college, constitute the subject of this article.

Any form of treatment capable of accelerating the germination of seeds possesses perhaps more scientific than practical value; but there are, nevertheless, some high-priced seeds which do not retain their germinating capacity very long, and, if the percentage of germination can be materially increased at a small expense, such a treatment would be worthy of practical consideration. It is not our purpose, however, to maintain, from the results shown in the following tables, that they warrant practical application.

The solutions selected for these experiments are those which are frequently found in seeds and seedlings; and it was thought that, by applying these solutions to the seeds for a certain number of hours, they might supply the deficiency in some essential constituent, and thus enable poorer and exhausted seeds to germinate. There are many seeds which do not retain the power of germinating very long; and it might be supposed that one cause of this had some

connection with the normal condition of the enzymes or ferments, which are essential for the conversion of certain seed products into available forms for germination. It is with this idea in mind that our experiments with solutions have been conducted; and the solutions selected have been those which are known to exist in many seeds and seedlings as ferments or enzymes, termed diatase, pepsin, trypsin and others, and amides, such as asparagin, leucin, etc. With the exception of diatase, all of the chemicals used in making these solutions were obtained from Mercks, the diatase being made up from malt. These experiments are by no means as complete as desired, but circumstances did not permit of their continuation at the time they were made.

Experiments with Asparagin Solutions.

Asparagin is a typical amide, found in connection with many seedlings and storage organs. During germination the amides increase in some instances to a considerable extent. Asparagin is especially abundant in leguminous seedlings, and is believed to play an important part in metabolism. The following tables, I. to V., represent the effects of asparagin solution upon different seeds which display considerable variation in their germinating capacity. One hundred seeds were used in all instances for each strength of solution, and the strength of solution varied in each experiment from .1 to 2 per cent. The seeds were soaked in asparagin twelve hours, after which they were rinsed with water and placed in Zurich germinators excluded from the light in a room with fairly even temperature. The number of seed germinating each day were taken out and recorded, no observations being made previous to twenty-four hours after placing them in the germinator. In many instances the number of observations have been omitted in the tables, to save space, and the percentages in the last columns give the final results. The relative gain, however, during this period, is practically the same as that preceding it. The seeds were in every instance left a few days or a week longer, in order to see if any more would germinate. We endeavored to select seed which did not show a high percentage of germination, but in every case this was not accomplished.

TABLE I. — *Showing the Effects of Asparagin Solutions upon the Germination of Alfalfa Seeds (Medicago sativa* L.).

Experiment A.

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).			
	1 (24 Hours).	2.	3.	4.
Normal,	65	85	87	88
2 per cent.,	81	92	97	97
1 per cent.,	85	96	98	99
.5 per cent.,	64	88	97	98
.25 per cent.,	73	93	98	99
.1 per cent.,	75	97	99	100

Normal average (per cent.), ... 88.0
Asparagin average (per cent.), ... 98.6

Experiment B.

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).	
	1 (24 Hours).	2.
Normal,	53	90
2 per cent.,	93	100
1 per cent.,	88	99
.5 per cent.,	95	100
.25 per cent.,	89	98
.1 per cent.,	88	100

Normal average (per cent.), ... 90.0
Asparagin average (per cent.), ... 99.4

Experiments *A* and *B* in the table show an acceleration in germination as well as a gain in the germinating capacity. Experiment *B* is a repetition of *A*. Both experiments lasted three days longer than indicated by the table, but no further germination occurred in either.

TABLE II. — *Showing the Effects of Asparagin Solutions upon the Germination of Rape Seeds (Brassica napus* L.).

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION.									
	1 (24 Hours).	2.	3.	4.	5.	6.	7.	8.	9.	10.
Normal,	–	–	–	–	–	2	8	16	25	68
2 per cent.,	1	1	2	2	4	11	23	39	47	97
1 per cent.,	5	5	5	6	10	10	14	17	28	85
.5 per cent.,	5	5	6	6	10	16	22	31	41	86
.25 per cent.,	6	7	10	12	17	28	40	51	58	90
.1 per cent.,	1	1	1	1	3	7	25	36	49	86

Normal average (per cent.), ... 68.0
Asparagin average (per cent.), ... 88.8

This experiment lasted three days longer than indicated in the table, and, as no further germination occurred, the experiment was discontinued.

TABLE III. — *Showing the Effects of Asparagin Solutions upon the Germination of Canadian Field Pea (Experiment A) and Vetch (Experiment B) Seeds.*

Experiment A.

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).		
	1 (24 Hours).	2.	3.
Normal,	3	98	100
2 per cent.,	12	98	100
1 per cent,	18	100	100
.5 per cent.,	27	100	100
.25 per cent.,	12	100	100
.1 per cent.,	17	99	100

Normal average (per cent.), . . . 100
Asparagin average (per cent.), . . . 100

Experiment B.

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).		
	1 (24 Hours).	2.	3.
Normal,	35	97	99
2 per cent.,	78	100	100
1 per cent,	84	100	100
.5 per cent.,	71	100	100
.25 per cent.,	83	100	100
.1 per cent.,	89	100	100

Normal average (per cent.), . . . 99
Asparagin average (per cent.), . . . 100

On account of the especially good seed used in these experiments, the results merely show an acceleration, due to the asparagin.

Table IV. — *Showing the Effects of Asparagin Solutions upon the Germination of Buckwheat Seeds (Fagopyrum esculentum* Moench).

Strength of Solution.	Percentage of Germination (in Days).								
	1 (24 Hours).	2.	3.	4.	5.	6.	7.	8.	9.
Normal,	1	36	60	65	71	71	71	71	71
2 per cent.,	1	42	71	76	77	77	77	77	77
1 per cent,	-	30	67	71	77	80	80	80	80
.5 per cent.,	-	47	80	86	91	92	92	92	92
.25 per cent.,	-	32	64	68	72	75	75	75	75
.1 per cent.,	-	43	75	79	80	83	84	84	85

Normal average (per cent.), ... 71.0
Asparagin average (per cent.), ... 81.6

No change in the results were shown when experiment was allowed to remain two days longer.

Table V. — *Showing the Effects of Asparagin Solutions upon the Germination of Serradella Seeds (Ornithopus sativus).*

Strength of Solution.	Percentage of Germination (in Days).								
	1 (24 Hours).	2.	3.	4.	5.	6.	7.	8.	9.	17.
Normal,	-	2	7	10	16	28	34	40	42	55
2 per cent.,	-	2	7	16	25	28	34	41	46	76
1 per cent.,	-	3	16	24	34	39	44	47	53	74
.5 per cent,	-	4	13	23	26	32	39	48	52	63
.25 per cent.,	1	6	16	22	31	34	38	44	51	74
.1 per cent.,	1	4	10	21	29	35	41	47	52	82

Normal average (per cent.), ... 55.0
Asparagin average (per cent.), ... 74.8

The seeds in this experiment failed to germinate further than shown in the table. Another experiment showed a corresponding acceleration, and at the end of fifteen days, when no more seed would germinate, the normal gave 54 per cent. and the treated averaged 79 per cent. One experiment with asparagus seed showed an acceleration throughout, and gave for the normal 40 per cent., while the treated was 45 per cent., — a gain of little consequence.

In considering the results of asparagin experiments as a whole, we find that the average percentage of germination for the normals in five experiments was 74.5 per cent.; that for the treated, 88.6 per cent. When the average percentage of the normal is compared with the .5 per cent. asparagin solution, we obtain 88.8 per cent. for asparagin and 74.5 per cent. for the normal.

In experiments dealing with seeds showing a small germinating capacity, some allowance must be made for individual variation, and it is better to use a large number of seeds in such cases, or, what is better, to have the experiment repeated a number of times with each species. Four experiments, however, of one hundred seeds, possess more value than one where four hundred seeds are used. After due allowance has been made for individual variation, it will be observed that the asparagin exerts an acceleration upon the germination of certain seeds, and also increases their germinating capacity. The various solutions of asparagin used show no detrimental effect upon the seeds.

Experiments with Leucin Solutions.

Leucin, like asparagin, is an amide, and is found frequently in connection with the latter in germinating seeds and seedlings. The seeds were soaked twelve hours in different strengths of solutions, and then rinsed before placing them in Zurich germinators, as in the asparagin experiments. Tables VI. and VII. give the result of two experiments with leucin.

TABLE VI. — *Showing the Effects of Leucin Solutions upon the Germination of Buckwheat Seeds (Fagopyrum esculentum Moench).*

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).								
	1 (24 Hours).	2.	3.	4.	5.	6.	7.	8.	11.
Normal,	-	20	56	68	72	72	72	72	72
1 per cent.,	-	20	61	68	70	72	73	73	74
.5 per cent.,	-	20	59	71	76	77	78	80	80
.25 per cent.,	-	11	51	64	71	74	74	75	80
.1 per cent.,	-	22	66	81	89	90	92	92	92
.05 per cent.,	-	21	61	74	76	78	78	79	80

Normal average (per cent.), ... 72 0
Leucin average (per cent.), ... 81 2

No further germination took place in the untreated seeds after the fifth day.

TABLE VII. — *Showing the Effects of Leucin Solutions upon the Germination of Alfalfa Seeds (Medicago sativa).*

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).				
	1 (24 Hours).	2.	3.	4.	5.
Normal,	43	87	90	90	90
1 per cent.,	43	90	93	95	96
.5 per cent.,	43	89	94	96	96
.25 per cent.,	46	95	98	98	98
.1 per cent.,	47	94	96	97	97
.05 per cent.,	51	95	98	98	98

Normal average (per cent.), ... 90.0
Leucin average (per cent.), ... 97.0

No further germination took place in the untreated seeds after the third day. Another experiment with alfalfa gave 89 per cent. for the normal and 98 per cent. for the treated seeds. The average of the three leucin experiments gave 83 per cent. for the normal and 92 per cent. for the treated. The various solutions of leucin had no injurious effect on the seeds.

Experiments with Pepsin Solutions.

Pepsin is a proteolytic ferment (enzyme), found in some seeds during germination, and is capable of converting non-diffusible proteids into diffusible ones. The seeds in the experiments shown in the two tables. VIII. and IX., were treated as in the preceding ones.

TABLE VIII. — *Showing the Effects of Pepsin Solutions upon the Germination of Crimson Clover Seeds (Trifolium incarnatum L.).*

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).						
	1 (24 Hours).	2.	3.	4.	5.	6.	7.
Normal,	9	21	25	27	27	28	28
5 per cent.,	9	22	29	31	33	36	36
2.5 per cent.,	10	19	26	30	35	39	43
1 per cent.,	17	26	31	37	39	40	42
.5 per cent.,	19	27	33	36	39	40	42
.25 per cent.,	16	23	31	36	39	41	43
.1 per cent.,	17	25	31	35	37	39	42

Normal average (per cent.), ... 28.00
Pepsin average (per cent.), ... 41 33

None of the seeds showed any further germination when left five days longer. Two other experiments with crimson clover were made: in one the normal seeds gave 22 per cent., the average of the treated seeds 38.6 per cent.; in the other, the normals were 22 per cent., while the average treated ones gave 33.8 per cent. The average of the three crimson clover experiments is: normal average, 24 per cent.; pepsin average, 34 per cent. The best results were obtained by the .25 per cent. solution in each experiment, and by comparing the results of this treatment we have for the normal averages 24 per cent. and pepsin averages 41 per cent.

TABLE IX. — *Showing the Effects of Pepsin Solutions upon the Germination of Cucumber Seeds (Cucumis sativus L.).*

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).											
	1 (24 Hours).	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Normal,	-	47	51	52	58	58	58	58	58	58	58	58
5 per cent.,	-	63	67	70	71	71	73	76	76	76	77	77
2.5 per cent.,	-	54	67	68	70	70	71	71	71	71	71	73
1 per cent.,	-	62	67	70	70	70	75	75	75	77	77	77
.5 per cent.,	-	58	56	58	58	58	63	63	66	70	70	70
.25 per cent.,	-	48	57	58	60	60	63	65	67	70	70	70
.1 per cent.,	-	53	56	58	60	63	69	71	72	75	75	75

Normal average (per cent.), ... 58.00
Pepsin average (per cent.), ... 73.66

None of the seeds showed any further germination. Another pepsin experiment with cucumber seeds gave for the normal 51 per cent. and an average of the treated was 68 per cent. Two pepsin experiments with vetch (*Vicia sativa*) gave precisely the same percentages of germination for both the normal and treated seeds, and all of the solutions except the .1 per cent. (which accelerated germination) resulted in a retardation. Yellow lupine seeds (*Lupinus luteus*) treated with the various pepsin solutions were also retarded, and alfalfa seeds responded to pepsin but slightly. It is known that pepsin does not exist, or at least has not been detected, in some germinating seeds. Among these is the lupine, and, from the results of the foregoing experiments, it would

appear not to be present, or at any rate play a very unimportant role, in such seeds as vetch and alfalfa.

Waugh* obtained favorable results with pepsin on tomatoes and watermelon seeds, but not with radish seeds. In our experiments the seeds showed a slight tendency to mould by the use of pepsin.

Experiments with Diastase Solutions.

Diastase, the starch-converting ferment, is probably the most widely distributed enzyme in the vegetable kingdom, it being found in seeds and mature parts of plants, and usually increasing during the mobilization of reserved food materials. The official solution used by chemists was prepared for this experiment, and consisted of 10 grams of fresh, finely ground malt, mixed with 200 cubic centimeters of water. This we have roughly designated, for convenience, as a 5 per cent. solution, from which the other percentages were obtained. The methods of treatment follow those in the preceding experiments.

TABLE X. — *Showing the Effects of Diastase Solutions upon the Germination of Black Barley Seeds* (*Hordeum sativum* Jessen).

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).					
	1 (24 Hours).	2.	3.	4.	5.	6.
Normal,	75	84	88	88	88	88
5 per cent.,	14	39	63	74	85	89
2.5 per cent.,	71	92	95	96	97	97
1 per cent.,	80	91	94	94	94	98
.5 per cent.,	82	95	96	97	98	98
.25 per cent.,	82	93	94	96	98	98
.1 per cent.,	81	96	96	96	96	97
.05 per cent.,	85	93	94	94	94	94

Normal average (per cent.), ... 88
Diastase average (per cent.), ... 95

* Tenth annual report, Vermont Experiment Station, pp. 106-111; also eleventh annual report, Vermont Experiment Station, pp. 290-295.

TABLE XI. — *Showing the Effects of Diastase Solutions upon the Germination of Upland Rice Seeds* (*Oryza sativa* L.).

STRENGTH OF SOLUTION.	PERCENTAGE OF GERMINATION (IN DAYS).			
	1 (24 Hours).	2.	3.	4.
Normal,	-	-	-	28
5 per cent.,	-	-	1	32
2.5 per cent.,	-	-	2	32
1 per cent.,	-	-	5	43
.5 per cent.,	-	-	5	41
.25 per cent.,	-	-	6	39
.1 per cent.,	-	-	5	42
.05 per cent.,	-	-	2	48

Normal average (per cent.), ... 28.0
Diastase average (per cent.), ... 39.5

Two other experiments were made, with black barley and with wheat seeds; the results, however, are of no consequence, inasmuch as the treated seeds became mouldy. This troublesome feature constituted the worst drawback in all of the diastase experiments. Waugh experienced the same trouble in the use of many of his solutions. This difficulty does not lie in the sterilization of the germinating appliances, but in the use of the solutions, which constitute excellent media for mould development. We therefore made the practice of rinsing all of the treated seeds with water before placing them in the germinators, which process helps keep down the moulds, but in some cases the moulds would appear even after the seeds had been rinsed. The results obtained from the foregoing experiments have already been sufficiently explained, and no further comment upon them is necessary here. In conclusion, it may be stated, however, that the study of the effects of amides and ferments and other accelerated factors upon seeds still offers a field for investigation worthy of a much more serious consideration than that given here.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

During the year which has elapsed since the last report the entomological work of the station has been conducted as usual, and with satisfactory results. An increasing amount of correspondence shows that the people of Massachusetts appreciate the opportunities afforded them for assistance more than formerly, and are availing themselves freely of that assistance.

The addition of a very complete set of apparatus for the photography of insects and their work has already been of much advantage to the division, as photographs from life are now being made, for use in the entomological publications of the station. The equipment in this line includes an enlarging, reducing and copying camera, a Premo camera for field work and another for use in photomicrography, all of which, with the necessary accessories, are in constant use.

Last spring a bulletin on the grass thrips was issued from this division, being a presentation of the practical and economic portions of the paper on the same subject by Mr. W. E. Hinds, which was published as an appendix to the last annual report of the college; and other bulletins on various important subjects are now being prepared. A catalogue of the Coccidæ of the world is also in preparation, and will probably be ready for publication during the coming year. Several papers on injurious insects have been written by Dr. H. T. Fernald, and published by the secretary of the Board of Agriculture of Massachusetts.

Many of the entomological bulletins from different stations have been bound for preservation and more convenient reference, and a number of valuable recent publications have been added to the insectary library.

Insects of the Year.

The past year has witnessed few serious insect attacks in Massachusetts. Why this was the case is difficult to determine, though it is possible that weather conditions last spring were in a measure responsible. An early warm period, continuing long enough to produce some of the earlier changes in insects from their winter conditions toward those of spring was followed by a colder period, which, coming after the initial changes had been taken, caught the insects in a state where they were unprepared for it, and may have caused the death of so many as to reduce their numbers. How far this explanation holds, however, cannot be determined.

The San José Scale.

This most serious pest to fruit growers has been present in Massachusetts a number of years. When it first made its appearance in the State it was believed by many that it had reached about its northern limit of distribution, and that its injuries would not be likely to be serious on that account. Time has shown, however, that this is not the case, and that the scale can not only become a very serious pest here, but that it can survive a temperature of thirty degrees below zero. The past summer, perhaps because of its dryness, has been distinctly favorable to the rapid increase of the scale and to a correspondingly increased destructiveness. As early as July 19 currants were received at the station so thoroughly covered by the young scales as to make them unsalable, and during the fall apples and pears were received in a similar condition. Up to the present year it was not known that fruit in Massachusetts could be so injured by the scale as to prevent its sale, though fruit trees killed by it were met with frequently. Now, however, the scale has demonstrated its ability to attack the fruit itself in this latitude, and this must call the attention of fruit raisers to the necessity of giving the most careful attention to their trees, if they desire to sell their products.

The scale has now been received from thirty-seven different towns in the State, and in all probability it occurs in as

many more. It is believed to have been exterminated in three places and in several others to be under control, but, as it is being sent in from other States on nursery stock each year, it is but a question of time when it will be present in almost every orchard, and destroy many of our ornamental trees and shrubs as well. That this is more than a mere fear is shown by the remark of a nurseryman in another State recently, when refused a certificate of inspection because of the presence of this scale: "Well, I can fill my Massachusetts orders with this stock, any way."

Much of the correspondence of the division of entomology has been about this and the other common scales, and, as little literature on the subject has recently been published in this State, a bulletin is being prepared upon these insects and the best methods of treatment for them.

Seventeen-year Locust.

This interesting insect appeared last June on Martha's Vineyard in considerable abundance. As this is the only place east of Pennsylvania where the brood due in 1900 has been found, it seemed desirable to make investigations as to the accuracy of previous observations, and to ascertain, if possible, whether this isolated colony was holding its own. Through the kindness of Mr. George Hunt Luce of West Tisbury, the necessary information and specimens were obtained, from which it appears that the brood is a well-known one on the island, and was as much in evidence as ever this year.

Birch Bucculatrix.

During September the birches were seriously attacked by the caterpillars of this insect, causing the leaves to become brown and noticeable, even at some distance. The injury was most apparent in the southern half of the State, except in the Connecticut valley, where it extended northward nearly to the State line. In 1887, 1890 and 1892 this insect was very abundant and destructive in Massachusetts, and has been present in smaller numbers every year. As it does not attract particular attention generally, it is not im-

probable that little will be seen of it in 1901, or, if abundant, that it will appear in the northern portions of the State, which escaped this year.

Marguerite Fly.

This little pest was sent to the station in February, 1900, with the statement that it was destroying the marguerites in the greenhouses of the sender. Careful studies upon its life history and methods for its destruction were at once commenced, and are now nearly completed. A successful, easy and inexpensive treatment for it has been discovered, and it is hoped that the results of the work will soon be in readiness for publication.

Greenhouse Aleurodes.

This insect has also caused much destruction in greenhouses in the State during the past year, a loss of four thousand dollars having been reported in one case, the damage being to early tomatoes and cucumbers, which were completely destroyed. Thorough investigations of the structure and life history of this insect are now being carried on at the insectary, together with a search for methods which will ensure its control.

Fall Canker Worm.

Little has been published upon the life history of the fall canker worm. During the year this insect has been raised from the egg, and its various stages fully described, much being added to our previous knowledge of the subject.

Pea-vine Louse.

Less has been heard about this insect than in 1899, though it has caused considerable loss in several places in the State. Whether it will increase in importance during 1901 is at least doubtful.

Faunal Distribution.

The distribution of insects is one of great interest and importance. Many of our worst pests will in all probability never extend as far north as Massachusetts, where the climatic

conditions are unfit for their continued existence. Certain portions of the State, however, appear to be so different from others in these regards that some insects may thrive there while unable to live elsewhere. It is of the utmost importance, therefore, to be able to locate these regions and their approximate limits, that we may know what the range of new insect foes will probably be. To this task the entomological division is giving much attention, already with many interesting and valuable results.

REPORT OF THE METEOROLOGIST.

JOHN E. OSTRANDER.

During the year, as in previous years, the work of this division has been mainly that of taking observations of the various features of the weather, and transcribing the records in convenient form for reference and preservation. With the report of last year were published the means of many of the records for a period of ten years. These results are now assumed to indicate normal conditions at this station, and the monthly means are compared with them, for the purpose of determining variation from the normal.

Bulletins of four pages each have been regularly issued at the beginning of each month, giving the more important daily records, together with mean monthly conditions and remarks on any unusual features of the month. The usual annual summary will be prepared and published with the December bulletin.

The New England section of the United States Weather Bureau has furnished daily, except Sunday, throughout the year the local forecasts for the weather of the following day, and the signals have been displayed from the flag staff on the tower. At the request of the section director, the weekly snow reports are being sent to the Boston office this season, as has been done the past few years.

The observations for the determination of the amount of soil moisture by the electrical method were started, but, owing to the failure of the apparatus to give any concordant results, the work was abandoned after an unsuccessful attempt to remedy the defects. The electrodes tried were those that last year gave fairly satisfactory results; the reason for their failure this year is not apparent. It is evident to the divi-

sion that further work with our present equipment would be unprofitable.

The true meridian established here two years ago has enabled the division to begin a series of observations on the declination of the needle. These observations are taken monthly, and the readings entered in the yearly record book. The results will be of value in deducing a formula for variation in declination for this locality, and also in making surveys with the compass.

The only addition to the equipment during the year consists of an "adder," for facilitating the computation of mean daily temperatures from the hourly readings on the Draper temperature chart.

At the opening of the college, in September, Mr. A. C. Monahan, the observer, retired from the division, and was succeeded by the assistant observer, Mr. C. S. Rice.

REPORT OF THE AGRICULTURIST.

WM. P. BROOKS; ASSISTANT, H. M. THOMSON.

The work of the agricultural division of the experiment station has been carried on during the past year upon the same general lines as those which have been followed in recent years. The usual variety of problems has presented itself for experimental inquiry, and the work has been more extensive than in any previous year. As in previous years, a very large share of our attention has been directed to solving some of the many problems connected with the use of manures and fertilizers. Our experiments in this line employ three distinct methods, viz., plot experiments in the open field, experiments in cylinders plunged to the rim in the ground, and pot experiments. The results of the last two will not be discussed in this report.

Plot Experiments.

A considerable number of these has been carried out upon our own grounds. On these, we have used one hundred and sixty-five plots, varying in size from about one-fortieth of an acre in case of some experiments to two or three acres in others, the average size of the plots being perhaps about one-tenth of an acre. Fifty-five plots have been used in such experiments upon land hired for the purpose. The nature of the experiments carried out upon these plots will be made plain by the following statement: —

To determine the relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen, and the extent to which the introduction of a crop of the clover family can make the use of nitrogen unnecessary, — eleven plots.

To determine the relative value of muriate and of sulfate of potash used in connection with bone meal, — eleven plots.

To determine the relative value of nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen, and of muriate of potash and sulfate of potash as sources of potash for garden crops, — seven plots.

To determine the relative value of kainite, and of the muriate, high-grade sulfate, low-grade sulfate, carbonate, silicate and nitrate as sources of potash, — forty plots.

To determine the relative efficiency of equal money's worth of dissolved bone-black, ground South Carolina rock, ground Florida phosphate, Mona guano and phosphatic slag as sources of phosphoric acid, — six plots.

To determine the relative efficiency of equal quantities of phosphoric acid, furnished in the following materials: acid phosphate, dissolved bone-black, dissolved bone, fine-ground raw bone, fine-ground steamed bone, fine-ground South Carolina phosphate, fine-ground Florida phosphate, phosphatic slag, apatite, Navassa phosphate, — thirteen plots.

To determine the relative value of manure alone, as compared with a smaller quantity of manure and a moderate amount of potash, for the corn crop, — four plots.

To determine the relative value of mixtures of fertilizer materials, furnishing, on the one hand, nitrogen, phosphoric acid and potash in the same proportions as in average corn fertilizers, and a mixture of similar materials containing more potash, — four plots.

Soil test with mixed grass and clover, — fourteen plots.

Soil test and experiment to determine the effect of liming for onions, — twenty-four plots.

Experiment in manuring grass lands, — three plots.

Experiment to determine the value of nitrate of soda for the rowen crop, — twelve plots.

Experiment in the use of fertilizers for orchard trees, — five plots.

Experiment to determine the relative efficiency of manure hauled and spread as fast as made, compared with manure put into large piles and spread in the spring, — ten plots.

Alfalfa, on which the effect of liming the soil is being studied, occupies four plots.

One of the plot experiments upon hired land has for its object the determination of the value of nitragin, or germ

fertilizer, for various legumes, and includes forty plots; while fifteen plots in another locality have been used in a soil test with grass as the crop.

Most of the problems upon which we hope to obtain light by means of these experiments have engaged our attention for a number of years. As might naturally be expected, the results are somewhat affected by season, as well as by numerous other causes which are not fully under control. Results in some cases have varied to some extent from year to year, and such variation must always be looked for in experiments of this character. This variation, of course, renders interpretation of the results a matter of much difficulty. Moreover, from the very nature of the questions engaging our attention, it is necessary that the work should continue over a considerable series of years before conclusions of general interest and importance can be drawn. It does not, therefore, seem best to publish in full the details concerning any considerable number of these experiments. Attention, however, will be called to some of the conclusions which it is believed are fully warranted by the results, not of the past year alone, but of a continuous line of investigations touching these points, many of which have continued for ten or more years.

I. — The Relative Value of Manures furnishing Nitrogen.

The experiments on which the conclusions now to be stated are based have been carried out on Field A, and a detailed description of the plan of experiment followed will be found in our twelfth annual report. These experiments were begun in 1890, and the crops grown have been oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover and potatoes. As the result of these experiments, we have found, taking into account all experiments from the beginning of the work up to date, that the various manures supplying nitrogen rank in the following order: nitrate of soda, barnyard manure, sulfate of ammonia and dried blood. If we allow numbers to express the relative efficiency of these materials, their standing is as follows: nitrate of soda,

100; barnyard manure, 90; sulfate of ammonia, 89; dried blood, 86; the plots receiving no nitrogen, 68.

It should be pointed out: (*a*) That the figure for barnyard manure is probably not a correct indication of the relative efficiency of the nitrogen it contains, because barnyard manure supplies humus and considerable quantities of lime, magnesia and other minerals which are not supplied by the fertilizers used on the other plots. These constituents of the barnyard manure are in almost all cases useful. The crops where manure is used, therefore, stand relatively higher than the availability of the nitrogen alone would warrant. (*b*) It is important to point out, further, that the relative standing of the sulfate of ammonia is lower than it undoubtedly would have been had lime been more largely used. Before these plots were limed the crops in some years were almost an absolute failure. Comparing the yields on the sulfate of ammonia with those on the nitrate plots for the years only which immediately follow the application of lime, we find, representing the yield on the nitrate of soda as 100, that the yield of the sulfate of ammonia is 101. The conclusion is inevitable, that, if we are to depend upon sulfate of ammonia as a source of nitrogen, we shall be obliged upon many of our soils to occasionally use considerable quantities of lime in connection with it. Since, however, a given quantity of nitrogen in the form of sulfate of ammonia costs more than the same quantity in the form of nitrate of soda, it is evident that the latter should usually be preferred. The nitrate of soda, however, is not so readily used in mixture with other fertilizers, on account of its tendency to become moist. Such materials as sulfate of ammonia and dried blood are far more likely to remain dry, and can therefore be more readily incorporated with other materials in manufacturing fertilizers or in making home mixtures.

II. — Crops of the Clover Family (Legumes) as Nitrogen Gatherers.

This experiment is carried out in connection with the experiments to determine the relative value of different materials furnishing nitrogen on Field A. Both soy beans and

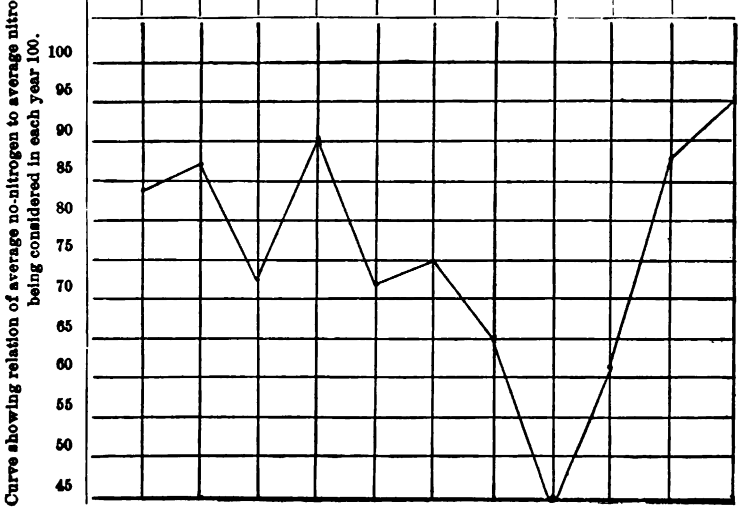
clover have been used, the former during three years, the latter one year; but it should be understood that the crops of both are harvested. We have aimed to test, not the effect of ploughing under these crops, but simply the improvement, if any, derived from their roots and stubble. The results indicate little or no improvement in the condition of the soil following culture of the soy bean, while a great improvement followed the turning under of the clover sod. The following table, with the curve below it, will, it is believed, make these facts clear: —

Effect of Leguminous Crops upon the Following Crop (Pounds).

PLOTS.	1890. Oats.	1891. Rye.	1892. Soy Bean.	1893. Oats.	1894. Soy Bean.	1895. Oats.	1896. Soy Bean.	1897. Oats.	1898. Oats.	1899. Clover.	1900. Potatoes.
Nitrogen plots,	343	484	1,965	598	620	494	1,740	445	254	413	1,316
No-nitrogen plots,	290	421	1,443	540	452	370	1,143	197	158	367	1,254

[Per cent. average no-nitrogen to average nitrogen.]

1890. Oats.	1891. Rye.	1892. Soy Bean.	1893. Oats.	1894. Soy Bean.	1895. Oats.	1896. Soy Bean	1897. Oats.	1898. Oats.	1899. Clover.	1900. Potatoes.
84.5	87.0	73.5	90.5	72.9	75.0	65.7	44.3	62.2	88.9	95.3



The plots, three in number, from which the average of the so-called no-nitrogen plots was obtained, have received no nitrogen-containing manure or fertilizer since 1884. The past season, therefore, is the sixteenth since these plots have been manured with anything containing nitrogen. The fact that after this long period potatoes on a clover sod give a crop amounting to 95.3 per cent. of that on plots which have yearly received a fair amount of manure or fertilizer containing nitrogen is certainly one of much significance, and strikingly illustrates the advantage which may be derived from the growth of clover under appropriate conditions. The actual yields of potatoes this year, although not large, were good; the no-nitrogen plots giving a yield at the rate of 209 bushels to the acre, and the nitrogen plots an average yield at the rate of 219.3 bushels per acre.

III. — The Relative Value of Muriate and High-grade Sulfate of Potash.

The experiments on which the following statements concerning relative value are based have been carried out on Field B, and have been in progress since 1892. The potash salts named are used in equal quantities, each continuously upon one-half of the plots, while all the plots have received a yearly application of fine-ground bone at the rate of 600 pounds per acre throughout the entire period. The potash salts were used yearly, at the rate of 400 pounds per acre, from 1892 to 1899. During the past year they have been applied at the rate of 250 pounds per acre. Full details concerning these experiments will be found in recent annual reports.

During the time that this experiment has continued the following crops have been grown on the field: potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans and cabbages. Crops have generally been good. Among these crops the potatoes,* clovers, cabbages and soy beans

* Potatoes have been grown upon our grounds under conditions making it possible to compare the yield of sulfate of potash with that of muriate of potash in fourteen different experiments; and as the average of all these experiments, if we represent the yield of sulfate of potash by 100, that of muriate is represented by the number 94.1, and in almost all instances the potatoes on the sulfate have been richer in starch and of better eating quality than those raised on the muriate.

have with very few exceptions done much the best on the sulfate of potash; while the yield of corn, grasses, oats, barley, vetches and sugar beets has been equally good on the muriate. The quality of the crops of potatoes and sugar beets produced by the sulfate of potash plots has been distinctly better than that of the crops produced on muriate of potash. Taking all the crops except the clovers into consideration, if we represent the efficiency of the high-grade sulfate of potash by the number 100, that of the muriate of potash is 98.1. Taking into account only those crops showing the preference for the sulfate of potash, and representing the efficiency of that salt by the number 100, the efficiency of the muriate of potash is 88.6. The present difference in price between the two salts is only about $5 per ton. The conclusion, therefore, appears to be warranted, that, under conditions similar to those prevailing in this experiment, the selection of the sulfate rather than the muriate is wise.

Further, in estimating the significance of our results, it should be kept in mind that the continued use of muriate of potash causes the loss with drainage waters of large amounts of lime. In the experiments on which the conclusions above stated are based we have yearly supplied a large amount of lime in the bone meal used, and accordingly the productiveness of the field even where the muriate of potash has been used has been fairly well maintained. Results on other fields on our farm indicate that when not used in connection with lime the muriate of potash stands much lower than the sulfate within comparatively few years. Whoever under ordinary conditions uses muriate of potash continuously, must sooner or later lime his land; and this is equally true, whether the farmer purchases muriate of potash and applies it by itself or in a home-made mixture, or if it is the source of the potash in a mixed fertilizer which he purchases. In deciding upon the purchase of any of the ordinary fertilizers upon the market, it is important to inquire whether the potash found in the fertilizer is present in the form of muriate or in the form of sulfate; and, other things being equal, the fertilizer containing its potash in the form of sulfate should be selected, unless the soil on which the material is to be

used is exceptionally light. The soil in the experiments on which the conclusions here presented are based is a medium loam. On a lighter soil the results would possibly be more favorable to the muriate.

As has been stated, the yield of the clovers has not been taken into account in making the calculations upon which the statements concerning the relative efficiency of the two potash salts are based. The reason why they have not been so taken into account is because there have always been more or less weeds produced among the clovers, and these have not been separated. The amount of weeds has naturally been greater in proportion as the clovers have been thinner and poorer. The figures, therefore, showing yields on the several plots in the form of hay, including the weight of the dried weeds as well as the weights of the dried clovers, do not correctly represent the effect of the fertilizers; accordingly, these figures have been discarded. There is, however, not the slightest doubt that in its effects upon the growth of the clovers the sulfate of potash stands distinctly ahead of the muriate. In some years and upon some plots the difference has been very large, at other times it has been smaller, and in a few instances the weight of the harvested product grown on muriate of potash has slightly exceeded that grown on the sulfate. It is without hesitation, however, that farmers are advised to employ sulfate of potash rather than the muriate, where good clover crops are desired, particularly unless prepared to use lime as well as potash salts liberally. If lime be liberally used, as indicated by our experiments on other fields, good clover can be grown on muriate of potash; but the combined cost of the lime and muriate will in most cases exceed the cost of the sulfate.

IV.—Field C.

A. The Relative Value of Nitrate of Soda, Sulfate of Ammonia and Dried Blood as Sources of Nitrogen.

The experiments upon which the conclusions now presented are based have been in progress since 1891, each of the several sources of nitrogen being applied yearly throughout the entire period upon the same plot. The crops grown

during this series of years have included spinach, lettuce, onions, garden peas, table beets, early cabbages, late cabbages, potatoes, tomatoes, squashes, turnips, sweet corn and celery, and each of these as a rule has been grown a number of years. Up to 1898, chemical fertilizers alone were employed in these experiments. During the past three years stable manure has been applied in equal quantities to each of the plots, while the chemical fertilizers have been used in the same amounts and applied to the same plots as at first. Taking into account the period when chemical fertilizers only were used, and the crops (spinach, lettuce, onions, table beets, garden peas and early cabbages) whose period of growth is the comparatively early part of the season, we find the relative efficiency of the different materials used as the source of nitrogen: —

Nitrate of soda,	100.0
Dried blood,	86.6
Sulfate of ammonia,	83.6

For the same period, and taking into account those crops (tomatoes, garden beans and sweet corn) making much of their growth after hot weather fairly sets in, we find the relative standing as follows: —

Nitrate of soda,	100.0
Dried blood,	97.8
Sulfate of ammonia,	103.5

For the period since manure has been applied, and taking into account the early crops only (spinach, lettuce, table beets, onions, garden peas and potatoes), the relative standing is: —

Nitrate of soda,	100.0
Dried blood,	88.8
Sulfate of ammonia,	61.7

For the same period, taking into account the aggregate yield of all the late crops (tomatoes, cabbages, turnips, squashes and celery), the relative standing is: —

Nitrate of soda,	100.0
Dried blood,	97.8
Sulfate of ammonia,	91.9

With one exception, it will be seen that the nitrate of soda here, as in the case of the field crops, proves the most efficient source of nitrogen. Its superiority is, however, much more marked, as should be expected, because it is immediately available, for the early crops. For the late crops in one instance during the earlier years of the experiment the sulfate of ammonia exceeded the nitrate of soda in efficiency, but during the later years of the experiment it has stood behind, even for these crops. It should be stated, further, in comment upon these results, that on one-half the plots in these experiments muriate of potash is used in connection with the various nitrogen manures. The combination of sulfate of ammonia and muriate of potash, as has been repeatedly pointed out in former reports, is a bad one, owing to the possible formation and poisonous influence of chloride of ammonia. It should be further pointed out that this field has not received the application of any lime throughout the years during which it has been under experiment. The availability of the sulfate of ammonia would undoubtedly be increased by giving this soil a heavy dressing of lime, since the presence of lime promotes those changes which are essential to convert the nitrogen of the sulfate of ammonia into nitrates, which are the most readily available nitrogen compounds.

B. Relative Value of Sulfate and Muriate of Potash for Garden Crops.

The period during which the experiments upon which the conclusions now to be stated are based and the crops grown are the same as in the case of the nitrogen fertilizers above discussed, and the relative standing of the two potash salts is shown for the same periods and crops.

Before Manure was used,—1891–97.

	Early Crops.	Late Crops.
Sulfate of potash, ...	100.0	100.0
Muriate of potash, ...	91.3	91.5

After Manure was used, — 1898–1900.

	Early Crops.	Late Crops.
Sulfate of potash,	100.0	100.0
Muriate of potash,	86.1	98.8

It should be noted that the muriate of potash stands much below the sulfate for all the periods, its inferiority being particularly marked in the case of the early crops. This marked inferiority in the latter years of the experiment for the early crops is doubtless in considerable measure due to the fact that the yields of such crops on the one plot where the muriate of potash and sulfate of ammonia are used together, which has always been exceedingly small, with the progress of time appear to be growing relatively worse. This is doubtless due in some measure to the fact that the continued use of muriate of potash has caused the loss of considerable lime, — an effect which had been noted and reported in a number of previous years.

The yields on the muriate, it may be said in conclusion, could undoubtedly be brought much nearer those on the sulfate by heavily liming the field.

V. — The Relative Value of Different Phosphates. (Field F.)

The phosphates under comparison in this experiment (which was begun in 1890) have been applied on the basis of equal money's worth, the idea being to determine whether it is more profitable to employ cheaper natural phosphates or one of the higher-priced dissolved phosphates. The plan of the experiment has been outlined in previous reports. It is necessary to state here, for clearness only, the following points: —

The phosphates compared on the basis of equal money's worth are dissolved bone-black, ground South Carolina rock, ground Florida rock, Mona guano and phosphatic slag. These phosphates were liberally applied during four years

(1890 to 1893, inclusive). Since 1893 no phosphate has been applied to any part of the field. All plots from the beginning were liberally manured with materials furnishing nitrogen and potash, and this manuring has continued on an even more liberal scale since 1893. The amounts of phosphoric acid supplied the several plots, the basis being equal money's worth, have of course varied widely. They are as follows: —

	Pounds.
Plot 1, phosphatic slag,	96.72
Plot 2, Mona guano,	72.04
Plot 3, ground Florida rock phosphate,	165.70
Plot 4, ground South Carolina rock phosphate,	144.48
Plot 5, dissolved bone-black,	49.36

The crop this year was cabbages, variety, Solid Emperor. The yield is shown in the following table: —

Comparison of Different Phosphates — Yield of Cabbages.

PLOTS.	Number over 2.25 Pounds.	Weight (Pounds).	Weight of Balance * (Pounds).
Plot 0,	3	8	95
Plot 1,	115	330	570
Plot 2,	73	250	580
Plot 3,	5	10	210
Plot 4,	111	550	960
Plot 5,	65	260	835

* Balance includes many small, hard heads, but too small for market.

The differences are very large, the ground South Carolina rock standing first, the phosphatic slag second, the Mona guano third, the dissolved bone-black fourth and the Florida phosphate last. The no-phosphate plot produced practically nothing. The plots are about one-seventh of an acre in area, and no plot has given what could be called a good crop. Last year the field was in oats, and there was but little difference between the yields of the different plots. The yield on all, even on the no-phosphate plot, was good.

In 1898 the crop on this field was corn, and the yield was good upon all plots except the no-phosphate plot and the

Florida phosphate plot, and there was no great difference between these yields. In 1897 the crop was Swedish turnips, and the relative growth on the different plots was about the same as this year in cabbages, the no-phosphate, the Florida phosphate and the dissolved bone-black giving the smallest yields, although the latter was not very much behind the balance of the plots.

Since the third year of the experiment the yields on the plots to which phosphatic slag, Mona guano and South Carolina rock phosphate have been applied have been substantially the same as on the dissolved bone-black plot, with the exception of the turnips and the cabbages, where the yields of these plots have been considerably greater than on the dissolved bone-black. All the crops grown upon the field, with the exception of the turnips and the cabbages, have given fairly good yields. The oat crop of last year was at the rate of about 40 bushels per acre; but even the no-phosphate plot gave practically the same yield as any of the others, so that the results with that crop really afford no light upon the particular question touched by this experiment. Taking into account all the crops which have been grown upon this field, except the Swedish turnips, which were affected by disease not apparently due to the fertilizer which had been used on a portion of the plots, and the yields of which, therefore, as expressed in figures, would be misleading, and representing the aggregate yield which stands highest by 100, the efficiency of the different phosphates is as follows: —

	Per Cent.
Phosphatic slag,	100.0
Ground South Carolina rock,	92.3
Dissolved bone-black,	90.7
Mona guano,	88.3
Florida phosphate,	71.5

There was at first no no-phosphate plot used in this experiment, but we have had a no-phosphate plot since 1895. Taking into account the yields of the several plots since 1895, and excepting the Swedish turnips, which were grown in 1897, for reasons above stated, the phosphates have the following relative rank: —

	Per Cent.
South Carolina rock phosphate,	100.0
Phosphatic slag,	99.0
Dissolved bone-black,	97.7
Mona guano,	95.4
Florida phosphate,	64.2
No-phosphate,	55.4

The crops which have been raised on the field in the order of their succession are as follows: potatoes, wheat, serradella, corn, barley, rye, soy beans, Swedish turnips, corn, oats and cabbages. All the plots in the field received an application of lime at the rate of one ton to the acre of quicklime, slaked, spread after ploughing and deeply worked in with a harrow in the spring of 1898.

This statement of the conditions of the experiment and of the relative yields on the different plots should perhaps be further supplemented by the statement that, supposing the crops harvested to have been of average composition and that there has been no waste, there would remain of the total phosphoric acid applied to the several plots the following amounts in each: —

	Pounds.
The phosphatic slag plot,	53.6
Mona guano,	29.7
Florida phosphate,	132.4
South Carolina rock phosphate,	102.0
Dissolved bone-black,	9.5

The following conclusions appear to be justified by the results which we have obtained: —

1. It is possible to produce profitable crops of most kinds by liberal use of natural phosphates, and in a long series of years there might be a considerable money saving in depending, at least in part, upon these rather than upon the higher-priced dissolved phosphates.

2. None of these natural phosphates appear to be suited to crops belonging to the turnip or cabbage family; but whether it is because these crops require the presence of an unusually large amount of soluble phosphoric acid, or whether it is because of some other effect of the dissolved phosphates, our experiments do not enable us to say. While we have obtained much the largest crops of turnips and cab-

bages on the natural phosphates, the yields have not been what could be considered good.

3. Between ground South Carolina rock, Mona guano and the phosphatic slag there is no considerable difference in the economic result.

4. The Florida phosphate, though used in amounts furnishing much more phosphoric acid than is furnished by either of the others, stands far behind them in yield, and would appear, therefore, to be rendered available only with extreme slowness.

In conclusion, it may be doubted whether, under the conditions prevailing in ordinary farm or garden practice, it would be wise to depend exclusively upon the natural phosphates. The best practice will probably be found to consist in using one of these in part, and in connection with it a moderate quantity of one of the dissolved phosphates.

VI. — Comparison of Phosphates on the Basis of Equal Application of Phosphoric Acid.

The phosphates under comparison on this basis include apatite, South Carolina rock phosphate, Florida soft phosphate, phosphatic slag, Navassa phosphate, dissolved bone-black, raw bone, dissolved bone, steamed bone and acid phosphate. The experiments have been in progress three years, each phosphate being applied yearly to the same plot. There are three no-phosphate plots, which serve as a basis for comparison. The plots are one-eighth of an acre each in area.

During the past year two crops have been grown upon this field: oats, which were cut and made into hay; and Hungarian grass, also made into hay. The yields have been large on all plots, varying from a little less than 4 tons per acre for the two crops on the poorest no-phosphate plot to rather over 5 tons per acre for the two crops on the dissolved bone-black which gave the largest yield. The only points to which it seems desirable to call attention are the following: —

1. The phosphatic slag evidently furnished phosphoric acid in an exceedingly available form, the yield this year being almost equal to that on the dissolved bone-black.

2. The Florida soft phosphate is apparently a very inferior material, the phosphoric acid evidently becoming available only with great slowness.

3. Steamed bone meal appears to be inferior in availability to raw bone meal.

Soil Tests.

During the past season two soil tests have been carried out upon our own grounds, both in continuation of previous work upon the same grounds. The same kinds of fertilizers have been applied to each plot and in the same amounts as last year. The fertilizers in these experiments are used in accordance with the co-operative plan for soil tests adopted in Washington in 1899. Each fertilizer wherever employed is always applied at the following rates per acre: —

Nitrate of soda, . .	160 pounds, furnishing nitrogen.
Dissolved bone-black, .	320 pounds, furnishing phosphoric acid.
Muriate of potash, .	160 pounds, furnishing potash.
Land plaster, . .	400 pounds.
Lime, ...	400 pounds.
Manure, . . .	5 cords.

Soil Test with Grass (South Acre).

The past is the twelfth season that the experiment on this field has been in progress. The field has been cropped in successive years as follows: corn, corn, oats, grass and clover, grass and clover, corn followed by mustard as a catch-crop, rye, soy beans, white mustard, corn, corn, and this year grass and clover seeded in early spring. During all this time four of the fourteen plots into which the field is divided have received neither manure nor fertilizer. Three plots have yearly received a single important manurial element, nitrogen, phosphoric acid or potash, every year the same; three have received each year two of these elements; one has received all three yearly; and one each has received, yearly, lime, plaster or manure. The larger part of the field accordingly has remained either entirely unmanured or has had but a partial manuring, and the degree of exhaustion of most of the plots is considerable. The four nothing plots this year produced an average at the rate of 930 pounds of hay per acre. The following table shows the rate of yield of the several plots: —

Effect of the Fertilizers.

Hay (South Acre Soil Test, 1900).

FERTILIZERS USED.	Yield per Acre (Pounds).	Gain or Loss per Acre, compared with Nothing Plots (Pounds).
Plot 1, nitrate of soda,	2,460	1,660.00
Plot 2, dissolved bone-black,	1,000	200.00
Plot 3, nothing,	800	-
Plot 4, muriate of potash,	1,140	366.67
Plot 5, lime,	880	133.33
Plot 6, nothing,	720	-
Plot 7, manure,	4,160	3,440.00
Plot 8, nitrate of soda and dissolved bone-black,	2,540	1,440.00
Plot 9, nothing,	1,100	-
Plot 10, nitrate of soda and muriate of potash,	3,000	1,900.00
Plot 11, dissolved bone-black and muriate of potash,	1,600	500.00
Plot 12, nothing,	1,100	-
Plot 13, plaster,	900	—200.00
Plot 14, nitrate of soda, dissolved bone-black and muriate of potash.	2,300	1,200.00

The effect of each of the three elements of plant food, nitrogen, phosphoric acid and potash, is more clearly brought out in the tables below: —

	Results of the Addition of Nitrogen to —				
	Nothing.	Phosphoric Acid.	Muriate of Potash.	Phosphoric Acid and Potash.	Average Result.
Hay (pounds per acre),	1,660	1,240	1,533.33	700	1,283.33

Value of net average increment, ... $10 27
Financial result (gain), ... 7 07

	Results of the Addition of Phosphoric Acid to —				
	Nothing.	Nitrate of Soda.	Muriate of Potash.	Nitrate and Potash.	Average Result.
Hay (pounds per acre),	200	—220	133.33	—700	—146.67

Value of net average decrease, ... $1 17
Financial result (loss), ... 4 37

	Results of the Addition of Potash to —				
	Nothing.	Nitrate of Soda.	Phosphoric Acid.	Nitrate and Phosphoric Acid.	Average Result.
Hay (pounds per acre),	366.67	240	300	—240	166.67

Value of net average increment, ... $1 33
Financial result (loss), ... 1 87

	Results of the Addition to Nothing of—			
	Complete Fertilizer.	Manure.	Plaster.	Lime.
Hay (pounds per acre), . . .	1,200	3,440	—200	133.33
Value of increment, . . .	$9 60	$27 52	–	$1 07
Value of decrease, . . .	–	–	$1 60	–
Financial result, ...	No gain or loss.	2 52 gain.	3 40 loss.	0.13 loss.

These results require little comment. A study of the figures shows that it is the nitrate of soda chiefly which causes an increase in the crop. Alone and in every combination it gives a large increase. It should be remembered, in estimating the significance of these figures, that the field was seeded last spring, and that accordingly the crop was comparatively small. The effect of the fertilizers will undoubtedly become more pronounced another season, when both grass and clover are fully established. *It is especially noteworthy that nitrate of soda alone applied to a plot which has now received no other fertilizer for twelve years gives a crop of hay amounting to almost* 1¼ *tons. This plot last year gave a crop of corn at the rate of something less than* 14 *bushels per acre. The plot to which muriate of potash alone has been applied during the past twelve years gave us last year a yield of corn at the rate of nearly* 50 *bushels per acre. The hay crop this year is* 1,140 *pounds.* These comparisons, bringing out the differing effects of the same fertilizer on the same field for different crops, and still other comparisons which might be made, illustrate in a striking manner the fact that the selection of fertilizers for our average soils should be made chiefly with reference to the crop.

All plots in this field were evenly seeded with a mixture of grass and clover seeds, sown crosswise, to insure even seeding of all plots. Both grass and clover seeds came up well, and the clover was thick at the start on all plots. At the present time there is practically no clover on any of the plots except the four to which potash has been applied and the one to which manure has been yearly applied.

Soil Test with Onions (North Acre).

This experiment is upon the land occupied last year in a similar soil test with onions. The field has been employed in soil test work for eleven years, the several plots having

been every year manured alike, as described under soil test with grass. The previous crops in the order of rotation have been potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and ruta-baga turnips, potatoes, onions, and onions. It will be remembered that the west half of each plot was limed in the spring of 1899 at the rate of 1 ton per acre of quicklime, slaked, and immediately spread and harrowed in. The fertilizers were employed this year in the same quantities as last, viz.: —

	Pounds.
Nitrate of soda (per acre),	320
Dissolved bone-black (per acre),	640
Muriate of potash (per acre),	320

The seed was sown at the rate of 5 pounds per acre. The variety was Danvers' Yellow Globe. Germination was prompt and perfect, but many of the plants upon the nothing plots and upon the unlimed portion of the plots receiving respectively muriate of potash, nitrate of soda, nitrate of soda and muriate of potash, and dissolved bone-black and muriate of potash, soon died; while such plants as survived upon these plots made but very little growth. The following tables give the results of the harvest: —

Effect of the Fertilizers.

Onions (North Acre Soil Test, 1900).

Plot.	FERTILIZERS USED.	Yield per Acre of Scallions and Tops (Pounds).		Gain or Loss per Acre, compared with Nothing Plots (Pounds).	
		Unlimed.	Limed.	Unlimed.	Limed.
1	Nothing,	460	1,600	-	-
2	Nitrate of soda,	3,100	1,780	1,640	20
3	Dissolved bone-black,	1,160	880	—1,300	—1,040
4	Nothing,	3,460	2,080	-	-
5	Muriate of potash,	3,200	3,400	—455	1,050
6	Nitrate of soda and dissolved bone-black.	1,720	760	—2,130	—1,860
7	Nitrate of soda and muriate of potash.	1,100	4,520	—2,945	1,630
8	Nothing,	4,240	3,160	-	-
9	Dissolved bone-black and muriate of potash.	5,320	1,720	1,500	—1,980
10	Nitrate of soda, dissolved bone-black and muriate of potash.	5,600	1,520	2,200	—2,220
11	Plaster,	1,760	1,960	—1,220	—2,070
12	Nothing,	2,560	4,820	-	-

Onions (North Acre Soil Test, 1900).

Plot.	FERTILIZERS USED.	Yield per Acre of Well-cured Onions (Bushels). Unlimed.	Yield per Acre of Well-cured Onions (Bushels). Limed.	Gain or Loss per Acre, compared with Nothing Plots (Bushels). Unlimed.	Gain or Loss per Acre, compared with Nothing Plots (Bushels). Limed.
1	Nothing, ...	6.15	41.54	-	-
2	Nitrate of soda, ...	50.00	155.00	21.67	83.21
3	Dissolved bone-black, . .	17.31	37.69	—33.20	—64.36
4	Nothing, ...	72.69	132.31	-	-
5	Muriate of potash, . . .	37.69	383.46	—26.45	257.31
6	Nitrate of soda and dissolved bone-black.	225.77	202.31	170.20	82.31
7	Nitrate of soda and muriate of potash.	9.23	310.77	—37.80	196.93
8	Nothing, ...	38.46	107.69	-	-
9	Dissolved bone-black and muriate of potash.	159.62	380.00	124.91	273.66
10	Nitrate of soda, dissolved bone-black and muriate of potash.	136.92	488.46	105.96	383.46
11	Plaster, ...	4.62	23.08	—22.59	—80.57
12	Nothing, ...	23.46	102.31	-	-

	Results of the Addition of Nitrogen to — Nothing.	Phosphoric Acid.	Muriate of Potash.	Phosphoric Acid and Potash.	Average Result.
Scallions, unlimed (pounds), .	1,640	—830	—2,490	700	—245
Scallions, limed (pounds), . .	20	—820	580	—240	—115
Onions, unlimed (bushels), .	21.67	203.40	—11.35	—18.95	48.69
Onions, limed (bushels), . .	83.21	146.67	—60.38	109.80	69.83

Value of net average increment: unlimed, $12.66; limed, $18.16.
Financial result: unlimed, $6.26 gain; limed, $11.76 gain.

	Results of the Addition of Phosphoric Acid to — Nothing.	Nitrate of Soda.	Muriate of Potash.	Nitrate and Muriate of Potash.	Average Result.
Scallions, unlimed (pounds), .	—1,300	—3,770	1,955	5,145	507.50
Scallions, limed (pounds) . .	—1,040	—1,880	—3,030	—3,850	—2,450.00
Onions, unlimed (bushels), .	—33.20	148.53	151.36	143.76	102.61
Onions, limed (bushels), . .	—64.36	—.90	16.35	186.53	34.41

Value of net average increment: unlimed, $26.68; limed, $8.95.
Financial result: unlimed, $20.28 gain; limed, $2.55 gain.

	Results of the Addition of Potash to —				
	Nothing.	Nitrate of Soda.	Phosphoric Acid.	Nitrate and Phosphoric Acid.	Average Result.
Scallions, unlimed (pounds), .	—455	—4,585	2,800	4,330	522.50
Scallions, limed (pounds),. .	1,050	1,610	—940	—360	340.00
Onions, unlimed (bushels), .	—26.45	—59.47	158.11	—64.24	1.99
Onions, limed (bushels), . .	257.31	113.72	338.02	301.15	252.55

Value of net average increment: unlimed, $0.52; limed, $65.66.
Financial result: unlimed, $5.88 loss; limed, $59.26 gain.

	Results of the Addition to Nothing of —			
	Complete Fertilizer.		Land Plaster.	
	Unlimed.	Limed.	Unlimed.	Limed.
Onions (bushels per acre), . .	105.96	383.46	—22.59	—80.57
Value of net increment, . . .	$27 55	$99 70	-	-
Value of decrease, ...	-	-	$5 87	$20 95
Financial result, ...	8 35 gain.	80 10 gain.	9 47 loss.	24 55 loss.

The yield upon the limed portion of many of the plots this year is, as was anticipated, much better than last year, although the tops on all parts of the field were somewhat prematurely killed by blight. The heavy application of lime made in that year appears to have corrected in large measure the faulty soil conditions. *We have this year a crop at the rate of nearly* 500 *bushels to the acre of well-cured onions upon the limed half of the plot, which has been yearly manured with nitrate of soda, dissolved bone-black and muriate of potash; while on the unlimed portion of the same plot we have a yield of* 136.9 *bushels to the acre. The lime has evidently proved highly beneficial.*

Particular attention is called to the fact that we nowhere obtained a fairly good crop except upon those plots to which potash has been yearly supplied. The limed portion of the plot, which has yearly been manured with muriate of potash alone, gives a yield at the rate of 383 *bushels to the acre; the nitrate of soda and the potash give a yield at the rate of about* 311 *bushels; the dissolved bone-black and potash, a yield at the rate of* 380 *bushels. These figures make it perfectly evident that potash is an exceedingly important manure*

for the onion crop. Its effects far exceed those of either of the other elements.

Our results make it equally evident that the continuous use of muriate of potash makes the employment of lime an absolute necessity. The combined cost of the muriate of potash and the lime necessarily used with it is likely to be greater than would be the cost of some other source of potash.

That the nitrate of soda as well as the muriate of potash has proven in some degree injurious when used without lime is made equally evident by our results, for the yield on the combined nitrate of soda and muriate of potash without lime is much inferior to the yield on the muriate alone without lime. It is, indeed, almost the poorest in the field.

Especial attention is called to the fact, which was very evident on all the plots where it was used, that dissolved bone-black greatly promoted the perfect ripening of the crop. By far the best ripened crop on the unlimed portion of the field was the crop produced by nitrate of soda and dissolved bone-black. Any other dissolved phosphate would undoubtedly have a similar effect.

Attention is called, further, to the fact that the dissolved bone-black in large measure corrects the injurious effects following the use of muriate of potash. This is made especially evident by the comparison between the yields where dissolved bone-black was used together with nitrate of soda and muriate of potash and where the last two fertilizers were used alone. Where they were used alone, the crop, as has already been pointed out, was almost the poorest in the field, a large share of the plants dying at a very early stage in their growth; while where the dissolved bone-black was used together with these fertilizers a moderate crop was the result. It becomes evident, therefore, that where fertilizers containing a liberal amount of some dissolved phosphate are employed, liming is less necessary than where such phosphates are not employed. That this should be so is not strange, since all dissolved phosphates contain a large amount of sulfate of lime (land plaster), which, if used in large quantities, produces many of the effects ordinarily following the use of lime.

Practical Advice on Fertilizers for Onions.

Although further investigations are called for concerning the many questions connected with using fertilizers for onions, it is believed that the results thus far obtained justify the following advice: —

1. Mixed fertilizers which are to be used for the culture of onions where nothing else is employed should contain about 3 to 4 per cent. nitrogen, 5 to 6 per cent. available phosphoric acid and 8 to 10 per cent. potash. It is believed that the nitrogen of such fertilizers should be derived in about equal proportions from nitrate of soda, dried blood and dry ground fish or tankage. It is further believed that the source of potash should be either the sulfate or carbonate. Such a fertilizer might be required in amounts varying from 1 to 1½ tons.

2. If a home mixture of materials is to be made, it is believed that it should supply 60 pounds of nitrogen, from 90 to 100 pounds of phosphoric acid and 160 to 200 pounds of potash per acre. It is believed, further, that the nitrogen, as stated above, should be derived in part from nitrate of soda and in part from animal materials. It is believed that the phosphoric acid should be derived mainly from acid phosphate or dissolved bone-black, and that for potash either the high or low grade sulphate or the carbonate of potash-magnesia should be employed. As an illustration of a mixture which it is believed will suit average conditions, the following list of materials is given: —

	Pounds.
Nitrate of soda,	200
Dried blood,	250
Dry ground fish or tankage,	200
Acid phosphate,	700
For potash, either of the following: —	
High-grade sulfate,	350
Low-grade sulfate,	700
Carbonate of potash-magnesia,	950

These materials should be mixed just before use, spread after ploughing and harrowed in.

3. It is suggested, the suggestion being based upon our observations, that in case the onions do not ripen well, and where the proportion of scallions is large, the application of lime be tried, or the proportion of acid phosphate increased. If lime is to be used, it is recommended that about 1 ton of quicklime per acre be applied. This should be slaked with water, spread after ploughing, and deeply worked in with wheel harrow. The best season is autumn or very early spring.

"Special" Corn Fertilizer *v.* Fertilizer richer in Potash.

The experiments upon which it is now proposed to comment have for their object the effort to determine the most profitable combination of fertilizers to be used for the growth of corn. The plan of the experiment and the results up to the close of last season are given in full in our last annual report.

Results in recent years had led to the conclusion that this field might be benefited by liming. It accordingly received an application at the rate of 1 ton of air-slaked lime, applied May 14 and thoroughly worked in. The kinds and amounts of fertilizers used during the past season have been somewhat changed. To two of the plots (1 and 3) in the field we have applied materials supplying the same quantity of nitrogen, phosphoric acid and potash as would be furnished by the use of 1,800 pounds of fertilizer, having the average composition of the "special" corn fertilizers analyzed at this experiment station in 1899. This average is as follows: —

	Per Cent.
Nitrogen,	2.37
Phosphoric acid,	10.00
Potash,	4.30

The fertilizers analyzed varied widely in composition, the range for each of the elements being shown by the following: —

	Per Cent.
Nitrogen,	1.5- 3.7
Phosphoric acid,	9.0-13.0
Potash,	1.5- 9.5

The other plots in the field received an application of materials practically the same in kind and quantity as have been recommended in Bulletin No. 58 for corn on soils poor in organic matter. The principal difference between the manuring of these plots and the others is that they receive slightly more nitrogen, much less phosphoric acid and considerably more potash. The materials supplied to the several plots are shown in the following table: —

FERTILIZERS USED.	Plots 1 and 3 (Pounds Each).	Plots 2 and 4 (Pounds Each).
Nitrate of soda,	30.0	50.0
Dried blood,	30.0	-
Dry ground fish,	37.5	50.0
Acid phosphate,	273.0	50.0
Muriate of potash,	37.5	62.5

The variety of corn grown this year was Sibley's Pride of the North. The growth was vigorous and healthy, and unaffected, so far as could be seen, by any abnormal conditions. The yields were as follows: —

Yield of Corn, 1900.

PLOTS.	Ears (Pounds).	Stover (Pounds).
Plot 1 (lesser potash),	1,510	1,460
Plot 2 (richer in potash),	1,435	1,540
Plot 3 (lesser potash),	1,590	1,675
Plot 4 (richer in potash),	1,515	1,600

Average Yield per Acre.

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Plots 1 and 3,	77.50	6,270
Plots 2 and 4,	73.75	6,280

It will be noticed that the yield of grain on the "special" fertilizer exceeds that on the fertilizer richer in potash, the

difference being at the rate of 3.8 bushels per acre; the fertilizer richer in potash gave slightly more stover. The difference in cost of the fertilizers applied on the two sets of plots is at the rate of a little more than $4 per acre. This is the apparent cost of the 3.8 bushels of corn. I say apparent, for the following reason: the field was seeded to mixed grass and clover the latter part of July, and at the present time the condition of plots 2 and 4, which received the fertilizer richer in potash, indicates a much heavier growth of clover next season than on the other plots.

It is believed that when this field is once more broken up and put into corn the yields of plots 2 and 4 will stand relatively better.

In conclusion, attention is called to the fact that the results on this field furnish important light upon the problem as to whether corn can be successfully grown on fertilizers alone. The present is the tenth year since this field has been under experiment, and throughout this time fertilizers only, and in very moderate quantities, have been employed. The result this year on the plots richer in potash is a crop at the rate of about 74 *bushels of sound corn and of* 3 *tons of stover per acre, and a magnificent catch of grass and clover.* The cost of the fertilizers employed this year on these plots is at the rate of $13.50 per acre, not including the lime. One ton of the latter was put on this year, but such application will not be required oftener than once in six or seven years.

Manure alone *v.* Manure and Potash.

This experiment, which was intended to illustrate the relative value in crop production of an average application of manure, as compared with a smaller application of manure used in connection with some form of potash, was begun in 1890. Full accounts of the results in the different years will be found in preceding annual reports, and summaries are found in the reports for 1895 and 1900. The field contains one acre and is divided into four plots of one-fourth acre each. Corn was the crop in 1899. The field was ploughed last fall and seeded to rye for winter protection. After ploughing this spring the field received a dressing of air-slaked lime at

the rate of 1 ton to the acre; this was thoroughly worked in with a wheel harrow; the field was then manured as shown below: —

Plot 1, manure, 1½ cord; weight, 6,805 pounds.
Plot 2, manure, 1 cord; weight, 4,610 pounds; high-grade sulfate of potash, 40 pounds.
Plot 3, manure, 1½ cord; weight, 6,717 pounds.
Plot 4, manure, 1 cord; weight, 4,067 pounds; high-grade sulfate of potash, 40 pounds.

Samples of the manure used were analyzed, and the sulfate of potash was analyzed. The calculated amounts of plant food applied to the several plots are as follows: —

PLOTS.	Nitrogen (Pounds).	Phosphoric Acid (Pounds).	Potash (Pounds).
Plot 1,	22.64	19.65	38.43
Plot 2,	14.21	13.70	40.67
Plot 3,	20.15	20.15	27.54
Plot 4,	12.20	12.20	36.67

The variety of corn grown this year was Sibley's Pride of the North. The growth was good and the crop large on all plots. The yield on the several plots is at the rate per acre shown in the following table: —

Yield of Corn (Rate per Acre).

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Plot 1,	72.5	6,740
Plot 2,	72.0	7,020
Plot 3,	74.5	6,540
Plot 4,	72.8	6,580

Average Yield per Acre.

PLOTS.	Shelled Grain (Bushels).	Stover (Pounds).
Plots 1 and 3, manure alone,	73.5	6,640
Plots 2 and 4, manure and potash,	72.4	6,800

The crops, as in previous years, are of substantially equal value, the manure alone giving 1.1 bushels more grain than manure and potash, while the latter gave 160 pounds more stover. The combination, 4 cords of manure and 160 pounds sulfate of potash per acre, will cost about $6.40 less than 6 cords of manure alone. We have now grown eight corn crops on this field, and the average yields are at the rate per acre for the two manurings: —

Average of Eight Crops.

	Shelled Grain (Bushels).	Stover (Pounds).
Manure alone, ...	63.0	4,822
Less manure and potash, ...	58.7	4,497

The money cost of the materials applied to the plots receiving manure and potash for the ten years during which the experiment has continued is at the rate of about $81 less than on the other plots. The manure alone, however, has produced yields exceeding the combination of a smaller amount of manure and potash, at rates per acre amounting to shelled corn 34.4 bushels and stover 2,600 pounds. During two years since the experiment began the field has been in grass, and the yields on manure alone exceed those on manure and potash at rates per acre amounting to hay 2,244 pounds and rowen 1,170 pounds. Such an amount of corn and hay at average prevailing market prices would have been worth about $44.18. In using the large amount of manure alone, then, one would, in effect, allowing the manure to cost $5 to the cord on the land, have expended about $81 for products worth but little more than one-half that sum.

This field has now been seeded to mixed grass and clover seeds. The stand on all plots is good, but the clover is proportionally more abundant on the plots receiving the manure and potash.

It is believed that these experiments conclusively indicate that corn may be more cheaply grown on a combination of manure and potash than on manure alone.

The Relative Value for Green Manuring of the Soy Bean and Cow Peas.

So much has been said concerning the value of cow peas for green manuring purposes that it has seemed desirable to compare this crop with the soy bean for that purpose. Accordingly, two varieties of cow peas, the Wonderful and the Black, the former a late and the latter an early variety, have been grown under conditions allowing comparison with the medium green soy bean. The growth of all the crops was good and each occupied about one-fifth of an acre. The Wonderful cow pea when cut had only just begun to blossom, the Black had but a small proportion of its pods ripe, while all the pods on the soy bean were practically mature. The following table shows the results: —

Cow Peas and Soy Beans for Green Manuring.

VARIETY.	Pounds per Acre.		
	Green Weight.	Dry Matter.	Nitrogen.
Wonderful cow pea,	19,600	3,622	80.4
Black cow pea,	20,035	3,389	62.1
Medium green soy bean,	19,685	5,386	167.3

It will be noticed that the soy bean furnished much larger quantities both of dry matter and of nitrogen than either of the varieties of cow peas. It gave practically three-fifths more dry matter and more than double the nitrogen furnished by the better of the two varieties of cow peas. The roots of the bean were thickly studded with nodules, as also were the roots of the cow peas; and both must, therefore, have possessed the ability to draw upon the atmosphere for a considerable part of their nitrogen. It appears impossible to doubt that the manurial value of the soy beans must have been far greater than that of either of the varieties of cow peas.

In estimating the significance of these results, it should be kept in mind that the soil was a medium loam, retentive of moisture, and that the season had a fairly well-distributed

rainfall. It is not impossible that on lighter and less retentive soils, or with deficient rainfall, the cow pea may compare more favorably with the soy bean as a green manuring crop, for the latter is somewhat impatient of drought and of soils deficient in moisture.

It may be of interest to state in this connection that a portion of the area in soy beans was allowed to ripen, and that the yield was about 36 bushels per acre of thoroughly ripened seed.

Nitrate of Soda for Rowen.

Many experiments both here and elsewhere have convincingly shown the great value of nitrate of soda for application to mowings in early spring. Not many experiments appear to have been tried to determine the effect of such applications for the second crop. Accordingly plots were laid out in July in two of our mowing fields, for the purpose of carrying out an experiment to test this question. There were two sets of these plots. One set included four plots, laid out in a permanent mowing which was seeded twelve years ago, the principal species at the present time being Kentucky blue grass. The first crop was cut June 25. The nitrate of soda was applied July 1 to two plots at the rate of 150 pounds per acre. The first crop of hay on this land was at the rate of 2.16 tons per acre. The rowen was cut on these plots on September 7. The results are shown in the following table: —

Nitrate of Soda for Rowen.

PLOTS.	Pounds per Acre.	
	Nitrate of Soda applied.	Rowen harvested.
Plot 1,	Nothing.	2,082
Plot 2,	150	3,117
Plot 3,	Nothing.	2,438
Plot 4,	150	3,035

The average of plots 1 and 3 is at the rate of 2,260 pounds of rowen per acre; of plots 2 and 4 it is 3,076 pounds per acre. The application, then, of 150 pounds of nitrate of

soda, costing $3, gave an apparent increase of 816 pounds of rowen, at a cost for the fertilizer of .37 cents per pound.

The second set of plots occupied a portion of a field seeded to timothy in 1898. There were eight plots in this series. The first crop of timothy had been cut July 10, and the yield was at the rate of 2.6 tons per acre. The nitrate of soda was applied July 16. The following table shows the nature of the experiment and the results: —

Nitrate of Soda for Rowen.

PLOTS.	POUNDS PER ACRE.	
	Nitrate of Soda applied.	Rowen harvested.
Plot 1,	Nothing.	587
Plot 2,	150	1,394
Plot 3,	Nothing.	514
Plot 4,	150	679
Plot 5,	Nothing.	202
Plot 6,	200	1,137
Plot 7,	Nothing.	440
Plot 8,	250	1,816

The average yield of all the nothing plots was at the rate of 436 pounds per acre. The average of plots 2 and 4 was 1,036 pounds per acre, a gain of 600 pounds of rowen following the application of 150 pounds of nitrate, costing $3, the cost of the gain per pound being .5 cents. The application at the rate of 200 pounds produced an apparent gain of 701 pounds, at a cost of .57 cents per pound; the application at the rate of 250 pounds produced an apparent gain of 1,380 pounds, at a cost of .36 cents per pound; but we have some evidence indicating that this plot is naturally better than the average of the nothings.

In commenting upon these results, it should be stated at the outset that the season was not favorable for the production of a maximum effect from the application of the nitrate, as the rainfall was deficient, amounting, for the entire period during which the rowen upon the old mowing was growing, to 7.26 inches;* during the period that the timothy was growing, to 6.66 inches.† The application of the nitrate produced an effect both upon color and growth almost imme-

* The average for this period for the ten years 1889-98 is 8.59 inches.

† The average for this period for the ten years 1889-98 is 8.39 inches.

diately following the first rain which fell after it had been made. It is believed that the gain in crop would have been much greater had the rainfall been larger.

Further experiment is needed to determine what amount of nitrate, if any, it will pay to use; but the opinion is here advanced that probably the most profitable application will be found not to exceed about 150 pounds per acre.

Experiment in Manuring Grass Lands.

The system of using wood ashes, ground bone and muriate of potash, and manure in rotation upon grass land has been continued, with two slight modifications. We have three large plots (between two and one-half and four acres each) under this treatment. According to the system followed, each plot receives wood ashes at the rate of 1 ton per acre one year, the next year ground bone 600 pounds and muriate of potash 200 pounds per acre, and the third year manure at the rate of 8 tons. The changes in manuring introduced this year consist, first, in the use of a small quantity of nitrate of soda in connection with the ashes on one plot and with the ground bone and muriate of potash on another. The experiment is further modified to a slight extent by the fact that a little more than one acre on plot 1, which contains about four acres, was used for experiment in the application of nitrate of soda for rowen, elsewhere described in this report, the nitrate being used at the rate of 150 pounds per acre. Our system of manuring is so planned that each year we have one plot under each of the three manurings. The manure is always applied in the fall, the other materials early in the spring. The ashes were put on this year April 5, the bone and potash April 16. The nitrate of soda was used with the ashes at the rate of 64 pounds to the acre, and was put on April 17. Nitrate of soda was used on plot 3, with bone and potash in the quantities above named, at the rate of 83 pounds per acre. It was applied April 19.

Plot 1, which this year received wood ashes and nitrate of soda, gave a yield at the rate of 2.164 tons of hay and 1.326 tons of rowen per acre. Plot 2, which was top-dressed in the fall of 1899 with manure, yielded hay 1.525 tons and

rowen 1.150 tons per acre. Plot 3, which was manured with a combination of bone and potash in amounts named, and nitrate, gave yields of hay 2.228 tons and rowen (two crops on a part of the plot) 1.219 tons per acre. The average yield of the entire area for this year is 6,510 pounds, hay and rowen both included. The field has now been twelve years in grass, and during the continuance of the present system of manuring, since 1893, has produced an average product, hay and rowen both included, of 6,615 pounds per acre. The plots, when dressed with manure, have averaged 6,817 pounds per acre; when receiving bone and potash, 6,626 pounds; and when receiving ashes, 6,371 pounds. It will be noticed that, while the general average for this year, including all the plots, falls below the general average for the entire period, the average for this year of the two plots receiving bone and potash and ashes is above the general average for the entire period. It will be remembered, however, that these plots have this year, in addition to the usual amounts of bone and potash and ashes respectively, received a light dressing of nitrate of soda. It is possibly this difference in treatment which has produced the results just pointed out.

Poultry Experiments.

The experiments of the past season have, as in previous years, been devoted to the study of methods of feeding, as affecting egg-production. The only experiment the results of which it is proposed to report at the present time is one having for its object the determination of the relative merits of the system of giving a mash in the morning, as compared with the system of giving it late in the afternoon.

General Conditions.

Barred Plymouth Rock pullets, raised on the scattered colony plan, divided into two lots as equally matched in weight and development as possible at the beginning of the experiment, were employed. Twenty such pullets with two cockerels were put into each house. Our houses are detached, and include a closed room for nests and roosts, 10

by 12 feet, with two windows about 3 by 6 feet on the south, scratching shed, 8 by 12 feet, which is left either entirely open in fine weather or closed by folding doors with large glass windows in stormy weather, while the fowls are allowed the run of large yards whenever the weather permits.

Two tests were made: a so-called winter test, December 7 to May 20; and a summer test, May 29 to September 16. The feeds used in the two coops were of the same kinds, the intention being to give each lot of fowls as much food as would be readily consumed. The mash used in these experiments was commonly mixed with boiling water about twelve hours before use, but in some instances was given hot immediately after mixing. The morning mash was always given as soon after light as possible, the evening mash just before dark. The whole grain given to both lots of fowls was scattered in the straw in the scratching shed, for the fowls in one coop early in the morning, for those in the other coop about an hour before dark. Both lots of fowls were given a little millet seed scattered in the straw at noon, the object in view being to keep them industriously searching for food in the straw a considerable share of the time. About twice a week a small cabbage was given to each lot of fowls. The eggs were weighed weekly; all the fowls were weighed at intervals of about one month. Sitters were confined in a coop until broken up, being meanwhile fed like their mates. The prices per hundred weight for feeds upon which financial calculations are based are shown below: —

	Per Cwt.
Wheat,	$1 65
Corn and corn meal,	90
Millet,	1 00
Bran and middlings,	90
Gluten feed,	1 00
Gluten meal,	1 25
Animal scraps,	2 25
Clover,	1 50
Cabbage,	25
Oats,	1 12.5

The health of the fowls under both systems of feeding has been in general good, although, as is usually the case, there have been a few losses. Two fowls on the morning mash died

in April, and post-mortem examination showed a catarrhal condition of the throat and intestines. Three fowls in the evening mash coop died; post-mortem examination of one showing enlarged liver and spleen and ulcerated alimentary canal, and in another case enlarged liver and intestinal parasites.

Winter Experiment.

All details necessary to a full understanding of the experiment will, it is believed, be found in the following tables: —

Foods consumed, Morning v. *Evening Mash, December 7 to May 20.*

KIND OF FOOD.	Morning Mash (Pounds).	Evening Mash (Pounds).
Corn,	261.00	239.50
Wheat,	130.50	120.00
Millet,	39.50	37.75
Bran,	46.00	45.00
Meat scraps,	45.00	43.00
Clover,	22.00	21.50
Corn meal,	112.00	107.00
Cabbage,	62.50	77.75

Average Weights of Fowls (Pounds).

DATES.	MORNING MASH.		EVENING MASH.	
	Hens.	Cocks.	Hens.	Cocks.
December 7,	4.61	7.75	4.33	7.13
February 6,	5.38	7.38	4.78	6.88
March 17,	5.69	7.38	5.28	8.88
May 21,	5.24	7.88	5.13	6.88

Number of Eggs per Month, Morning v. *Evening Mash, Winter Test.*

DATES.	Morning Mash.	Evening Mash.
December,	1	1
January,	19	27
February,	76	52
March,	283	229
April,	271	292
May,	143	157
Totals,	793	758

Morning v. *Evening Mash for Egg-production, Winter Test.*

	Morning Mash.	Evening Mash.
Total dry matter in foods (pounds),	593.28	556.11
Number of hen days, not including males,	3,228	3,158
Number of hen days, including males,	3,558	3,488
Gross cost of food,	$7 78	$7 36
Gross cost of food per egg (cents),	.97	.97
Gross cost of food per hen day (cents),	.22	.21
Number of eggs per hen day,	.25	.24+
Average weight per egg (ounces),	1.84	1.85
Total weight of eggs (pounds),	91.19	87.64
Dry matter consumed per egg (pounds),	.75	.73+
Nutritive ratio,*	1:6.3+	1:6.1+

* The term nutritive ratio is used to designate the ratio existing between the total nitrogenous and the non-nitrogenous constituents of the feeds used, the former being regarded as a unit, and fat multiplied by 2.5.

Summer Experiment.

The method of feeding during the summer experiment was the same as in the winter, save in two particulars: first, in place of cut clover rowen in the mash, lawn clippings in such quantities as the fowls would eat before wilting were fed three times a week, to the hens in all the houses the same; and, second, the feeding of cabbages was discontinued. The yards, 1,200 square feet in area for each house, were kept fresh by frequent turning over of the soil. The tables give all details: —

Foods consumed, Morning Mash v. *Evening Mash, May 29 to September 16.*

KIND OF FOOD.	Morning Mash (Pounds).	Evening Mash (Pounds).
Bran,	41.80	40.70
Middlings,	41.80	40.70
Meat scraps,	32.00	32.00
Oats,	47.80	49.20
Corn meal,	41.80	40.70
Corn,	171.70	174.80

Average Weight of Fowls (Pounds).

DATES.	Morning Mash.		Evening Mash.	
	Hens.	Cocks.	Hens.	Cocks.
May 29,	5.60	8.00	4.94	6.75
July 30,	5.53	7.75	5.00	6.75
August 16,	5.11	8.00	4.74	7.00

Number of Eggs per Month, Morning v. *Evening Mash, Summer Test.*

DATES.	Morning Mash.	Evening Mash.
May,	28	24
June,	174	186
July,	163	181
August,	164	128
September,	54	51
Totals,	583	570

Morning v. *Evening Mash for Egg-production, Summer Test.*

	Morning Mash.	Evening Mash.
Total dry matter in foods (pounds),	337.02	338.11
Number of hen days, not including males,	1,719	1,722
Number of hen days, including males,	1,941	1,944
Gross cost of food,	$3 94	$3 95
Gross cost of food per egg (cents),	.68—	.69+
Gross cost of food per hen day (cents),	.20+	.20+
Number of eggs per hen day,	.34—	.33+
Average weight per egg (ounces),	1.83	1.90
Total weight of eggs (pounds),	66.68	67.69
Dry matter consumed per egg (pounds),	.51—	.59+
Nutritive ratio,*	1:5.5+	1:5.6

* The term nutritive ratio is used to designate the ratio existing between the total nitrogenous and the total non-nitrogenous constituents of the feeds used, the former being regarded as a unit, and fat multiplied by 2.5.

It will be seen that neither in the winter nor summer experiment was there any very considerable difference in the

number of eggs produced. It is, however, possibly significant, and this fact is made evident by the tables showing monthly egg yields, that during the period of shortest days the fowls receiving the evening mash laid less eggs than the others.

The most striking result of the experiments is the great difference in the relative amounts of droppings voided during the night by the fowls under the two systems of feeding. It was noticed from the beginning, and the same remained true throughout the entire period, that the amount of droppings voided during the night by the fowls receiving the evening mash was very much greater than the amount voided by the other lot of fowls. Weights were taken on a number of different occasions, with the results shown below: —

Morning v. *Evening Mash.*

DATES.	Number of Days Droppings.	MORNING MASH.		EVENING MASH.	
		Number of Hen Nights.	Weight of Droppings (Pounds).	Number of Hen Nights.	Weight of Droppings (Pounds).
March 3, ...	1	22	3.00	21	6.00
March 5, ...	2	44	5.25	42	11.00
March 7, ...	2	44	5.25	42	10.50
March 10, ...	1	22	2.50	21	6.25
March 21, ...	1	22	2.50	19	4.50

It will be noticed that the weight of the droppings voided during the night by the fowls receiving the evening mash during the period of nearly even days and nights during which these weights were taken is practically double the weight of the droppings of the other lot of fowls. The fact thus brought out is doubtless of much significance. It furnishes conclusive evidence that the digestive process in the case of a soft food like a mash is very rapid. The fact that digestion among birds is relatively much more rapid than with most classes of animals has been already many times pointed out. Forbush, in his paper in the report of the secretary of the State Board of Agriculture for 1899, gives valuable data bearing upon this subject concerning a number of the smaller birds and crows. Our experiments indicate that the ordinary domestic fowl, as might have been supposed would be the case, is also

able to digest soft foods with a degree of rapidity which seems astonishing. There has long been a general impression, and the usual practice in feeding fowls is evidence of this, that it is better to give the more solid food at night, especially during the winter, since it will "stay by" the fowls better. Our experiments indicate that this impression is well founded, and that the usual practice is correct, although they cannot be considered to prove it, because, of course, it may be that a period of comparative rest for the digestive organs during the night is better than the condition of more continuous work for these organs which would follow the use of solid food at night.

We have not obtained a sufficient difference in egg-production to be considered significant, but it is believed that the experiment, so far as it goes, indicates that it is better that the mash should be fed in the morning. It is conceivable, however, that, if the mash be given in too large quantities, the fowls will gorge themselves, will then as a consequence become inactive, and remain comparatively inactive during a considerable part of the morning; whereas, if they be given whole grain, for which they are required to scratch, they are of necessity more active. The relative weights of the fowls, particularly during the winter, afford some indication that we to some extent experienced this difficulty; for it will be noticed that the fowls receiving the morning mash, especially during the period of shortest days, weighed considerably more than the fowls receiving the evening mash.

It must, however, be further pointed out that the average difference in weight during the summer months was also considerable, amounting to about one-half pound at the time of each of the weighings. During the earlier part of this period, however, the fowls receiving the evening mash were producing the greater number of eggs, which difference may perhaps account for their decreased relative weight.

It is concluded that, so far as the results of this experiment enable one to judge, the morning mash is preferable to the evening; but it is evident that additional investigation is required in order to throw further light upon the subject.

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